Nokia Customer Care

# *Service Manual*

## RM-298; RM-299 (Nokia 2630)

# Mobile Terminal

***Part No: 9203123 (Issue 1)***

***COMPANY CONFIDENTIAL***

NOKIA
Care

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## Amendment Record Sheet

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## IMPORTANT

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# Warnings and cautions

## Warnings

- IF THE DEVICE CAN BE INSTALLED IN A VEHICLE, CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI-SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/ MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.
- THE PRODUCT MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES, FOR EXAMPLE, PETROL STATIONS (SERVICE STATIONS), BLASTING AREAS ETC.
- OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. CONSULT A PHYSICIAN OR THE MANUFACTURER OF THE MEDICAL DEVICE IF YOU HAVE ANY QUESTIONS. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.
- BEFORE MAKING ANY TEST CONNECTIONS, MAKE SURE YOU HAVE SWITCHED OFF ALL EQUIPMENT.

## Cautions

- Servicing and alignment must be undertaken by qualified personnel only.
- Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
- Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
- Use only approved components as specified in the parts list.
- Ensure all components, modules, screws and insulators are correctly re-fitted after servicing and alignment.
- Ensure all cables and wires are repositioned correctly.
- Never test a mobile phone WCDMA transmitter with full Tx power, if there is no possibility to perform the measurements in a good performance RF-shielded room. Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.
- During testing never activate the GSM or WCDMA transmitter without a proper antenna load, otherwise GSM or WCDMA PA may be damaged.


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## For your safety

### QUALIFIED SERVICE

Only qualified personnel may install or repair phone equipment.

### ACCESSORIES AND BATTERIES

Use only approved accessories and batteries. Do not connect incompatible products.

### CONNECTING TO OTHER DEVICES

When connecting to any other device, read its user's guide for detailed safety instructions. Do not connect incompatible products.


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## Care and maintenance

This product is of superior design and craftsmanship and should be treated with care. The suggestions below will help you to fulfil any warranty obligations and to enjoy this product for many years.

- Keep the phone and all its parts and accessories out of the reach of small children.
- Keep the phone dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits.
- Do not use or store the phone in dusty, dirty areas. Its moving parts can be damaged.
- Do not store the phone in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the phone in cold areas. When it warms up (to its normal temperature), moisture can form inside, which may damage electronic circuit boards.
- Do not drop, knock or shake the phone. Rough handling can break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the phone.
- Do not paint the phone. Paint can clog the moving parts and prevent proper operation.
- Use only the supplied or an approved replacement antenna. Unauthorised antennas, modifications or attachments could damage the phone and may violate regulations governing radio devices.

All of the above suggestions apply equally to the product, battery, charger or any accessory.


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## ESD protection

Nokia requires that service points have sufficient ESD protection (against static electricity) when servicing the phone.

Any product of which the covers are removed must be handled with ESD protection. The SIM card can be replaced without ESD protection if the product is otherwise ready for use.

To replace the covers ESD protection must be applied.

All electronic parts of the product are susceptible to ESD. Resistors, too, can be damaged by static electricity discharge.

All ESD sensitive parts must be packed in metallized protective bags during shipping and handling outside any ESD Protected Area (EPA).

Every repair action involving opening the product or handling the product components must be done under ESD protection.

ESD protected spare part packages MUST NOT be opened/closed out of an ESD Protected Area.

For more information and local requirements about ESD protection and ESD Protected Area, contact your local Nokia After Market Services representative.


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## Battery information

**Note:** A new battery's full performance is achieved only after two or three complete charge and discharge cycles!

The battery can be charged and discharged hundreds of times but it will eventually wear out. When the operating time (talk-time and standby time) is noticeably shorter than normal, it is time to buy a new battery.

Use only batteries approved by the phone manufacturer and recharge the battery only with the chargers approved by the manufacturer. Unplug the charger when not in use. Do not leave the battery connected to a charger for longer than a week, since overcharging may shorten its lifetime. If left unused a fully charged battery will discharge itself over time.

Temperature extremes can affect the ability of your battery to charge.

For good operation times with Ni-Cd/NiMh batteries, discharge the battery from time to time by leaving the product switched on until it turns itself off (or by using the battery discharge facility of any approved accessory available for the product). Do not attempt to discharge the battery by any other means.

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

Do not short-circuit the battery. Accidental short-circuiting can occur when a metallic object (coin, clip or pen) causes direct connection of the + and - terminals of the battery (metal strips on the battery) for example when you carry a spare battery in your pocket or purse. Short-circuiting the terminals may damage the battery or the connecting object.

Leaving the battery in hot or cold places, such as in a closed car in summer or winter conditions, will reduce the capacity and lifetime of the battery. Always try to keep the battery between 15°C and 25°C (59°F and 77°F). A phone with a hot or cold battery may temporarily not work, even when the battery is fully charged. Batteries' performance is particularly limited in temperatures well below freezing.

Do not dispose of batteries in a fire!

Dispose of batteries according to local regulations (e.g. recycling). Do not dispose as household waste.


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## Please send to:

NOKIA CORPORATION
Nokia Mobile Phones Business Group
Nokia Customer Care
PO Box 86
FIN-24101 SALO
Finland
E-mail: Service.Manuals@nokia.com


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## Nokia 2630 Service Manual Structure

1 General Information
2 Service Tools and Service Concepts
3 Baseband Troubleshooting Instructions
4 RF Troubleshooting Instructions
5 Camera Module Troubleshooting
6 System Module
Glossary


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# 1 — General Information


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## RM-298/RM-299 product selection

The RM-298 is the EU version of the telephone with a dual band transceiver unit designed for the GSM900 and GSM1800 networks.

The RM-299 is the US version of the telephone with a dual band transceiver unit designed for the GSM850 and GSM1900 networks.




**Figure 1 RM-298/299 product picture**

## Features

### Hardware features

- EGSM dualband 900/1800 for EMEA, APAC, China, LTA·
- GSM dualband 850/1900 for LTA
- Display: 128x160 TFT color display
- Codecs: HR, FR, EFR and AMR
- IHF Slim Malt 16mm Speaker
- Internal antenna
- Easy flash II system connector
- BT combined with FM radio
- VGA camera
- Built-in Vibra
- GPRS: Class 6


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## Software features

- OS: ISA
- UI Style: S40
- MIDP 2.0 Java, with latest APIs
- Browser: XHTML over TCP/IP (WAP 2.0 compliant)
- Video capture and playback (7.5fps, H.263; MPEG4)
- MMS 1.2
- English-Chinese dictionary for China/APAC
- E-mail Client 4
- Nokia Xpress audio messaging

## UI features

- Douglas V UI style with 3 soft keysl
- Nokia Series 40 user interface
- MP3 ringing tones & 40 polyphonic ringing tones
- Themes, colour games and wall papers
- Java games (downloadable)
- To-do list and Notes
- Countdown timer
- Phonebook image
- Menu with animated icons
- 2 font sizes are supported in the editor
- Calendar in day/week/month view
- Chinese lunar Calendar II (not for all regions)
- “Pulsating light” indicating missed call, unread messages, etc.

## Mobile enhancements

**Table 1 Power**

| Type | Name |
|---|---|
| BL-4B | Battery 700 mAh Li-Ion |
| AC-3 | Compact charger |
| AC-4 | Travel charger |
| AC-5 | Compact travel charger |
| CA-44 | Charger adapter |
| DC-4 | Mobile charger |

**Table 2 Car**

| Type | Name |
|---|---|
| CK-15W | Display car kit |


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| Type | Name |
|---|---|
| CK-20W | Multimedia car kit |
| CK-25W | Multimedia car kit |

**Table 3 Audio**

| Type | Name |
|---|---|
| HS-38W | Nokia bluetooth headset BH-202 |
| HS-40 | Headset |
| HS-47 | Stereo headset |
| HS-50W | Nokia bluetooth headset BH-300 |
| HS-51W | Nokia bluetooth headset BH-301 |
| HS-52W | Nokia bluetooth headset BH-201 |
| HS-58W | Nokia bluetooth headset BH-200 |
| HS-68W | Nokia bluetooth headset BH-203 |
| HS-73W | Nokia bluetooth headset BH-302 |
| HS-78W | Nokia bluetooth headset BH-100 |
| HS-79W | Nokia bluetooth headset BH-303 |
| HS-80W | Nokia bluetooth headset BH-208 |
| HS-84W/88W | Nokia bluetooth headset BH-204 |
| HS-85W | Nokia bluetooth headset BH-206 |
| HS-86W | Nokia bluetooth headset BH-207 |
| MD-4 | Mini speakers |

## Technical specifications

### General specifications

| Unit | Dimension LxWxT (mm) | Weight (g) | Volume (cc) |
|---|---|---|---|
| Transceiver with BL-4B 700mAh Li-Ion battery pack | 98x44x9.9 | 70 | 43 |

### Battery endurance

#### Nokia measurements of operation times in GSM900/1800

| Talk time | |
|---|---|
| Battery: BL-4B 700mAh | 400 mins |


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| Standby time | |
|---|---|
| Battery: BL-4B 700mAh | 350 hours |

**Note:** Variation in operation times will occur depending on SIM card, network settings and usage. Talk time is increased by up to 30% if half rate is active and reduced by 5% if enhanced full rate is active.

## Environmental conditions

| Environmental condition | Ambient temperature | Notes |
|---|---|---|
| Normal operation | -15 ºC ... +55 ºC | Specifications fulfilled |
| Reduced performance | -30 ...15 ºC and +55ºC ... +70 ºC | Operational only for short periods |
| Intermittent or no operation | -40 ºC ... -30 ºC and +70 ºC ... +85ºC | Operation not guaranteed but an attempt to operate will not damage the phone |
| No operation or storage | <-40 ºC and >+85 ºC | No storage. An attempt to operate may cause permanent damage |
| Charging allowed | -15 ºC ... +55 ºC | |
| Long term storage conditions | 0 ºC ... +85 ºC | |
| Humidity and water resistance | | Relative humidity range is 5 to 95%.<br>Condensed or dripping water may cause intermittent malfunctions.<br>Protection against dripping water has to be implemented in (enclosure) mechanics.<br>Continuous dampness will cause permanent damage to the module. |

## Electrical characteristics

**Table 4 Normal and extreme voltages**

| Voltage | Voltage (V) | Condition |
|---|---|---|
| General conditions | | |
| Nominal voltage | 3.90V | a |
| Lower extreme voltage | 3.30V | b |
| Higher extreme voltage | 4.30V | c |
| HW shutdown voltages | | |
| Vmstr+ | 2.1V ± 0,1V | Off to on |
| Vmstr- | 1.9V ± 0,1V | On to off |
| SW shutdown voltages | | |


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| | | |
|---|---|---|
| SW shutdown | 3. 1V | In call |
| SW shutdown | 3. 2V | In idle |
| Min operating voltage | | |
| Vcoff+ | 3. 1V ± 0,1V | Off to on |
| Vcoff- | 2. 8V ± 0,1V | On to off |
| HW reset demands | | |
| Min | 1. 0V | d |
| Max | -- | |

a. The nominal voltage is defined as being 15% higher than the lower extreme voltage. TA will test with this nominal voltage at an 85% range (0.85x3.9V [a] 3.3V).

b. This limit is set to be above SW shutdown limit in TA.

c. During fast charging of an empty battery, this voltage might exceed this value. Voltages between 4.20 and 4.60 might appear for a short while.

d. The minimum battery cell voltage required for the reset circuitry to turn on. This is not confirmed by measures at pt.

**Table 5 Current consumption**

| Condition | Min | Typical | Max | Unit |
|---|---|---|---|---|
| Call (MoU)<br>(E)GSM 900<br>GSM 1800<br>GSM 1900 | | 208<br>188<br>168 | | mA |
| Idle (MoU) | | 1.6 | | mA |
| Power off | 150 | | 250 | mA |


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# 2 — Service Tools and Service Concepts


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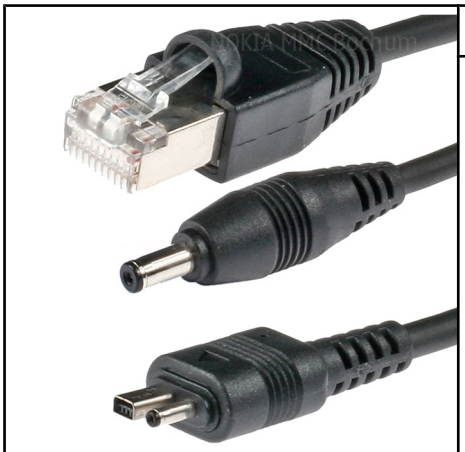
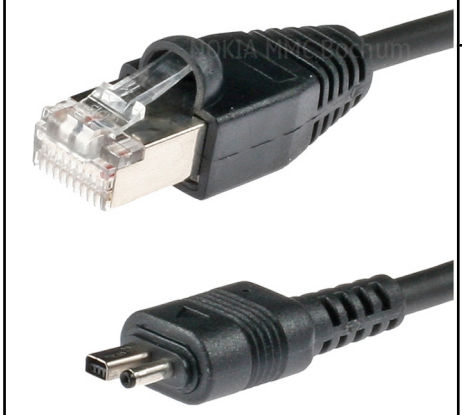

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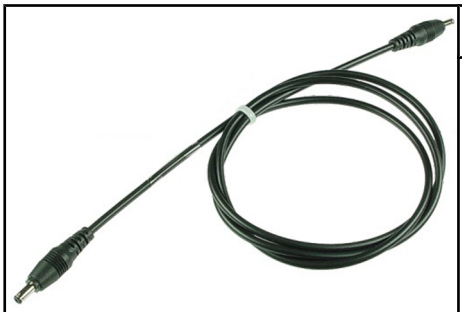

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## Service tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-298; RM-299, refer to various concepts.

| | | | |
|---|---|---|---|
|  | CA-106DS | Easy flash II cable | |
| | The cable is used for connecting phone DC port to the flash prommer FPS-10. | | |
|  | CA-111DS | Easy flash II cable | |
| | The cable is used for connecting phone DC port to either POS flashing device FLS-4S or to the PROMMER box FPS-11. | | |
|  | CA-112DS | Easy flash II cable | |
| | The CA-112DS easy flash II cable is used for connecting phone DC port to the PROMMER facilities (FLS-5, FPS-20). | | |


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| | | | |
|---|---|---|---|
|  | CA-41PS | Power cable | |
| | Power cable for connection of e.g. the JBV-1 docking station to the FPS-10 prommer box. | | |
|  | CA-52PS | DC Cable | |
| | The cable is used to connect JBV-1 docking station to the phone charger jack for ADC/VCHAR/ICHAR calibration. | | |
|  | CA-58RS | RF Cable | |
| | This RF cable is used together with MJ-138 to connect to RF measurement equipment. | | |
|  | DA-69 | Docking station adapter | |
| | The docking station adapter is used for this phone in combination with JBV-1. The adapter supports flashing and energy management calibration,<br>Features include:<br>• compatible with JBV-1<br>• easy phone attachment and detachment<br>• reliable phone locking<br>• switch for detecting phone<br>• replaceable SIM interface | | |


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| | | | |
|---|---|---|---|
|  | DAU-9S | MBUS cable | |
| | The MBUS cable DAU-9S has a modular connector and is used, for example, between the PC's serial port and module jigs, flash adapters or docking station adapters.<br>**Note:** Docking station adapters valid for DCT4 products. | | |
|  | FLS-4S | Flash device | |
| | FLS-4S is a dongle and flash device incorporated into one package, developed specifically for POS use. | | |
|  | FLS-5 | Flash device | |
| | FLS-5 is a dongle and flash device incorporated into one package, developed specifically for POS use. | | |


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| FPS-10 | Flash prommer | |
|---|---|---|

FPS-10 interfaces with:

- PC
- Control unit
- Flash adapter
- Smart card

FPS-10 flash prommer features:

- Flash functionality for BB5 and DCT-4 terminals
- Smart Card reader for SX-2 or SX-4
- USB traffic forwarding
- USB to FBUS/Flashbus conversion
- LAN to FBUS/Flashbus and USB conversion
- Vusb output switchable by PC command

FPS-10 sales package includes:

- FPS-10 prommer
- Power Supply with 5 country specific cords
- USB cable




| FPS-11 | Parallel flash prommer | |
|---|---|---|

FPS-11 interfaces with:

- PC
- Control unit
- Flash adapter
- Smart card

FPS-11 flash prommer features:

- Can flash up to 8 phones at a time, controlled by one PC
- Communication method between PC and FPS-11 is single USB2.0
- No need for external power for powering up phones
- Smart Card reader for SX-2 and SX-4
- Updates software
- Future feature: will support all DCT-4 protocols and models

FPS-11 sales package includes:

- FPS-11
- Power Supply for FPS-11
- EUR, UK, USA Power cords
- USB2.0 cable


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| JBV-1 | Docking station | |
|---|---|---|

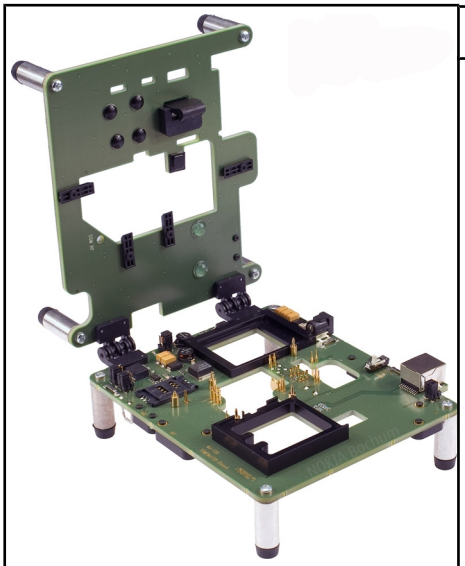
The JBV-1 docking station is a general tool that has been designed for calibration and software update use. The JBV-1 is used together with a docking station adapter as one unit

In calibration mode the JBV-1 is powered by an external power supply: 11-16V DC. When flashing the power for the phone must be taken from the flash prommer.

**Note:** JBV-1 main electrical functions are:

- adjustable VBATT calibration voltage, current measurement limit voltage: VCHAR, current measurement: ICHAR
- adjustable ADC calibration voltage via BTEM and the BSI signal
- BTEMP and BSI calibration resistor
- signal from FBUS to the phone via the parallel jig
- control via FBUS or USB
- Flash OK/FAIL indication


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| MJ-138 | Module jig | |
|---|---|---|

MJ-138 is meant for component level troubleshooting.

The jig includes an RF interface for GSM and Bluetooth. in addition, it has the following features:

- Provides mechanical interface with the engine and UI module
- Provides galvanic connection to all needed test pads in module
- Duplicated SIM connector
- Audio components: IHF, MIC
- Connector for control unit

**Note:** CA-58RS(RF cable) is used together with MJ-138. CA-58RS is not a part of the MJ-138 sales package and has to be ordered separately.

The following table shows the attenuation values for MJ-138:

| Frequency (Hz) | Loss (dB) |
|---|---|
| 836600000 | 0.24 |
| 881600000 | 0.24 |
| 897400000 | 0.25 |
| 942400000 | 0.25 |
| 1747800000 | 0.35 |
| 1842800000 | 0.37 |
| 1880000000 | 0.38 |
| 1950000000 | 0.40 |
| 1960000000 | 0.40 |
| 2140000000 | 0.40 |



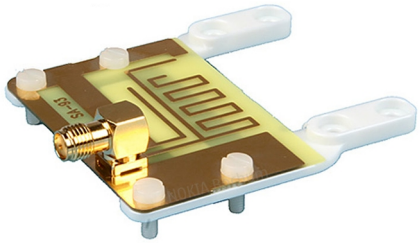
| PCS-1 | Power cable | |
|---|---|---|

The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled voltage.


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| | | | |
|---|---|---|---|
|  | PK-1 | Software protection key | |
| | PK-1 is a hardware protection key with a USB interface. It has the same functionality as the PKD-1 series dongle.<br>PK-1 is meant for use with a PC that does not have a series interface.<br>To use this USB dongle for security service functions please register the dongle in the same way as the PKD-1 series dongle. | | |
|  | PKD-1 | SW security device | |
| | SW security device is a piece of hardware enabling the use of the service software when connected to the parallel (LPT) port of the PC.<br>Without the device, it is not possible to use the service software.<br>Printer or any such device can be connected to the PC through the device if needed. | | |
|  | RJ-200 | Soldering jig | |
| | The jig is used for soldering and as a rework jig for the system module. It is made of lead-free rework compatible material. | | |
|  | RJ-51 | Rework jig | |
| | To be used with ST-30! | | |
|  | RJ-72 | Rework jig | |
| | To be used with rework stencil ST-32. | | |


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| SA-93 | RF coupler | |
|---|---|---|

The coupler is used for Go/No-Go test after changing components in the RF part of the phone.

It is mounted on the docking station adapter.

The following table shows attenuations from the antenna pads of the mobile terminal to the SMA connectors of SA-93:

| Band | Tuning channel | Attenuation RX (dB) | Attenuation TX(dB) |
|---|---|---|---|
| GSM850 | 128 | 8 | 8 |
| | 190 | 8 | 8 |
| | 251 | 8 | 8 |
| GSM900 | 38 | 8 | 8 |
| | 124 | 8 | 8 |
| | 975 | 8 | 8 |
| GSM1800 | 512 | 10 | 10 |
| | 700 | 10 | 10 |
| | 885 | 10 | 10 |
| GSM1900 | 512 | 10 | 10 |
| | 661 | 10 | 10 |
| | 810 | 10 | 10 |



| SRT-6 | Opening tool | |
|---|---|---|

SRT-6 is used to open phone covers and B-to-B connectors.

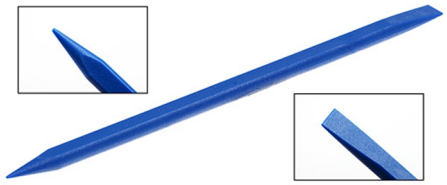
**Caution:** Handle the tool with care because the tip is only 0.7 mm in diameter.

When not in use, store in a safe location.



| SS-88 | Camera removal tool | |
|---|---|---|

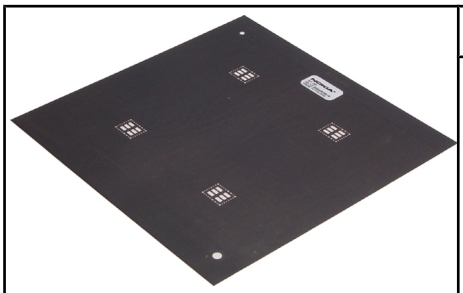
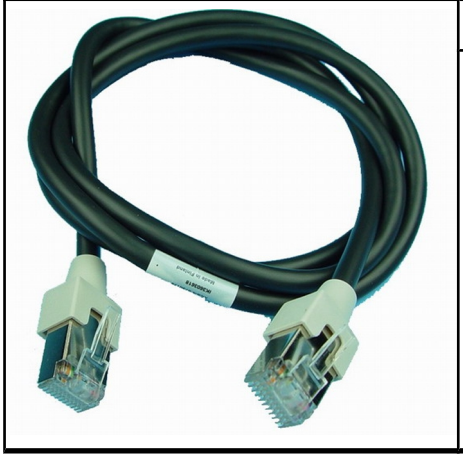
The camera removal tool SS-88 is used to remove/attach the front camera module from/to the socket.



| SS-93 | Opening tool | |
|---|---|---|

SS-93 is used for opening JAE connectors.


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| | | | |
|---|---|---|---|
|  | ST-30 | Rework stencil | |
| | It is used together with RJ-51 to rework N6301. | | |
|  | ST-32 | Rework stencil for B2100 | |
| | Rework stencil to be used together with RJ-72 for rework of B2100. | | |
|  | SX-4 | Smart card | |
| | SX-4 is a BB5 security device used to protect critical features in tuning and testing.<br>SX-4 is also needed together with FPS-10 when DCT-4 phones are flashed. | | |
|  | XCS-4 | Modular cable | |
| | XCS-4 is a shielded (one specially shielded conductor) modular cable for flashing and service purposes. | | |


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| | | | |
|---|---|---|---|
|  | XRS-6 | RF cable | |
| | The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment.<br>SMA to N-Connector approximately 610 mm.<br>Attenuation for:<br>• GSM850/900: 0.3+-0.1 dB<br>• GSM1800/1900: 0.5+-0.1 dB<br>• WLAN: 0.6+-0.1dB | | |

## Service concepts

### POS flash concept with FLS-4S

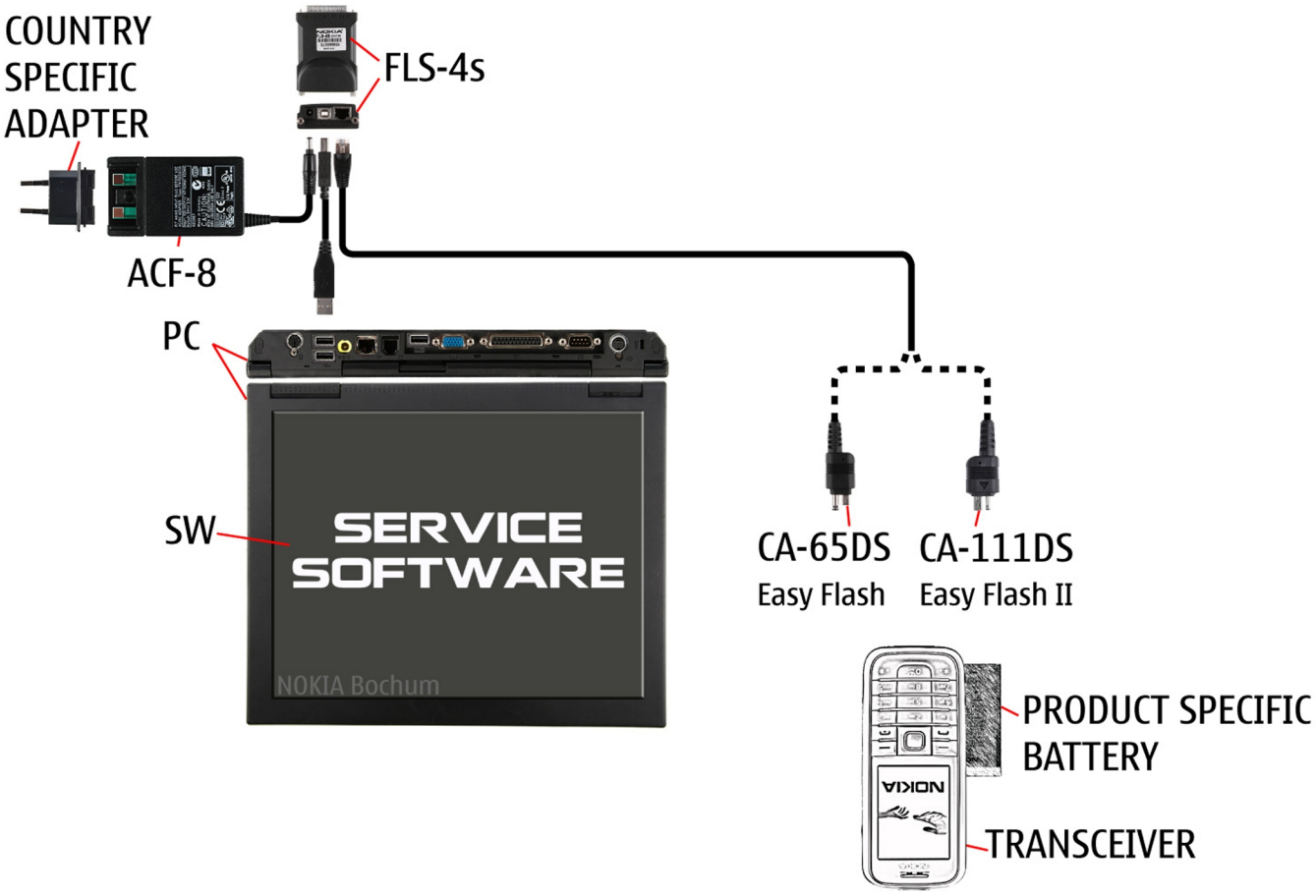



**Figure 2 POS flash concept with FLS-4S**


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## POS flash concept with FLS-5

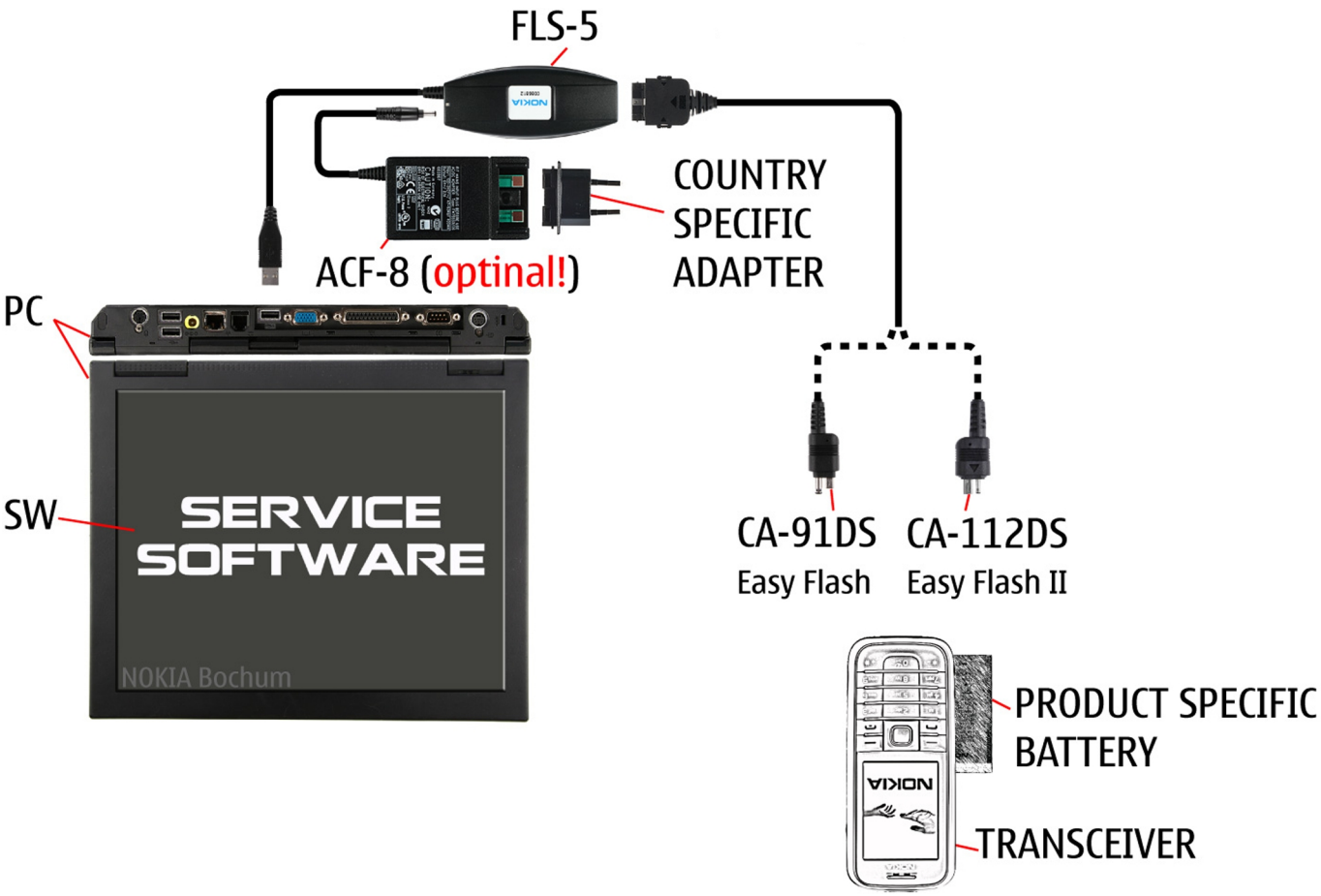



**Figure 3 POS flash concept with FLS-5**


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## Flash concept with FPS-10

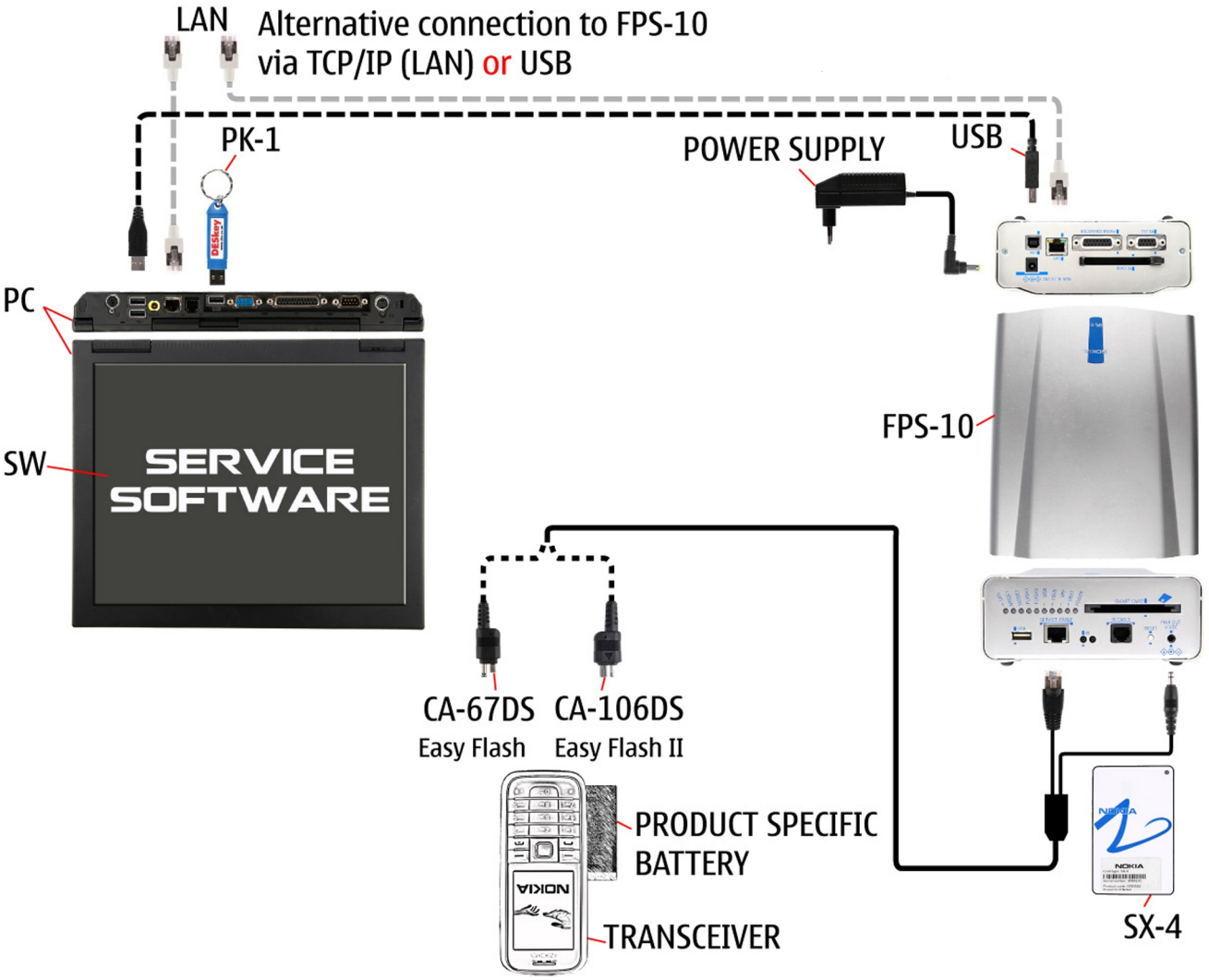



**Figure 4 Flash concept with FPS-10**


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## RF-test/BB-tune concept with JBV-1

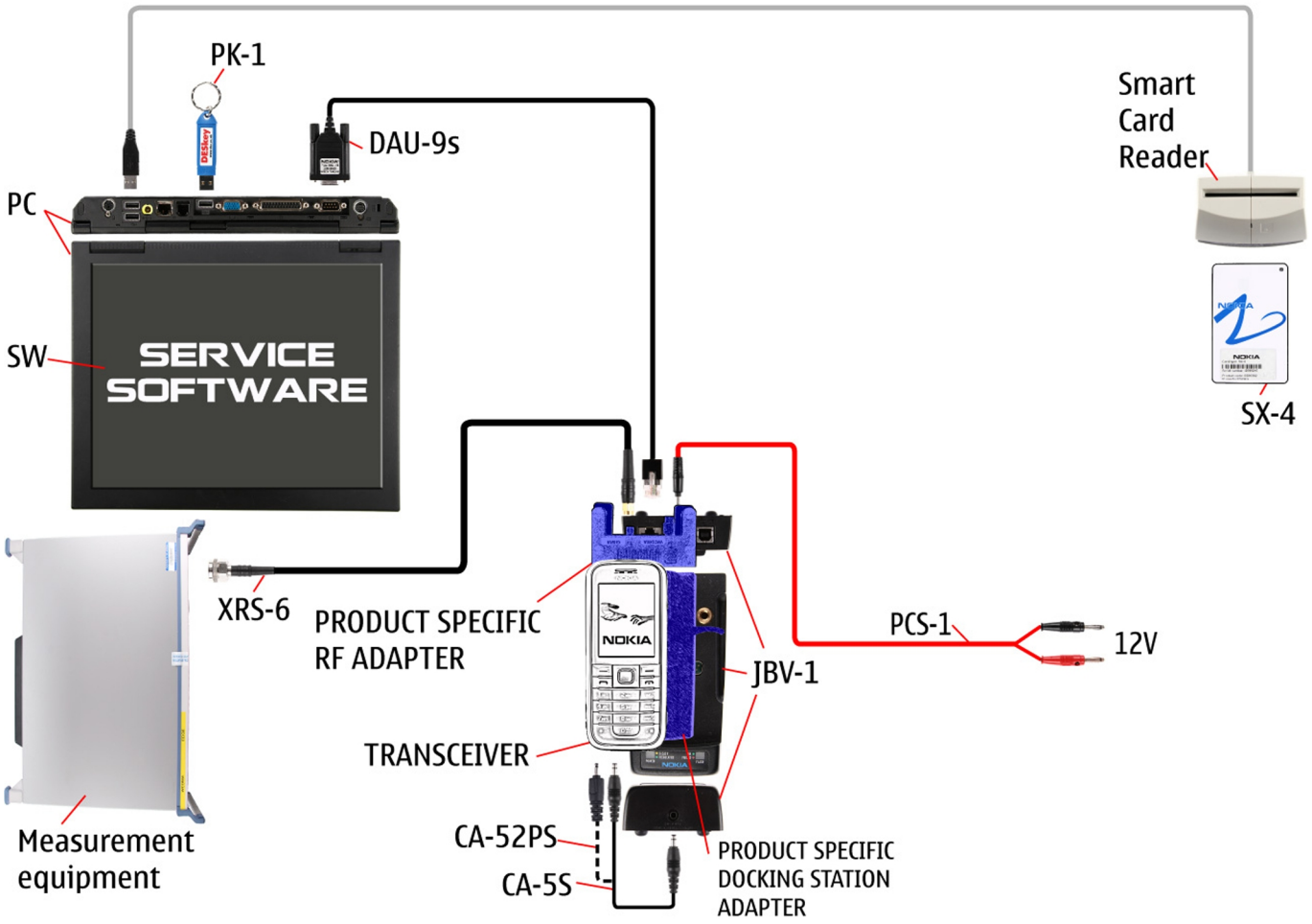



**Figure 5 RF-test/BB-tune concept with JBV-1**


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## EM calibration concept with JBV-1

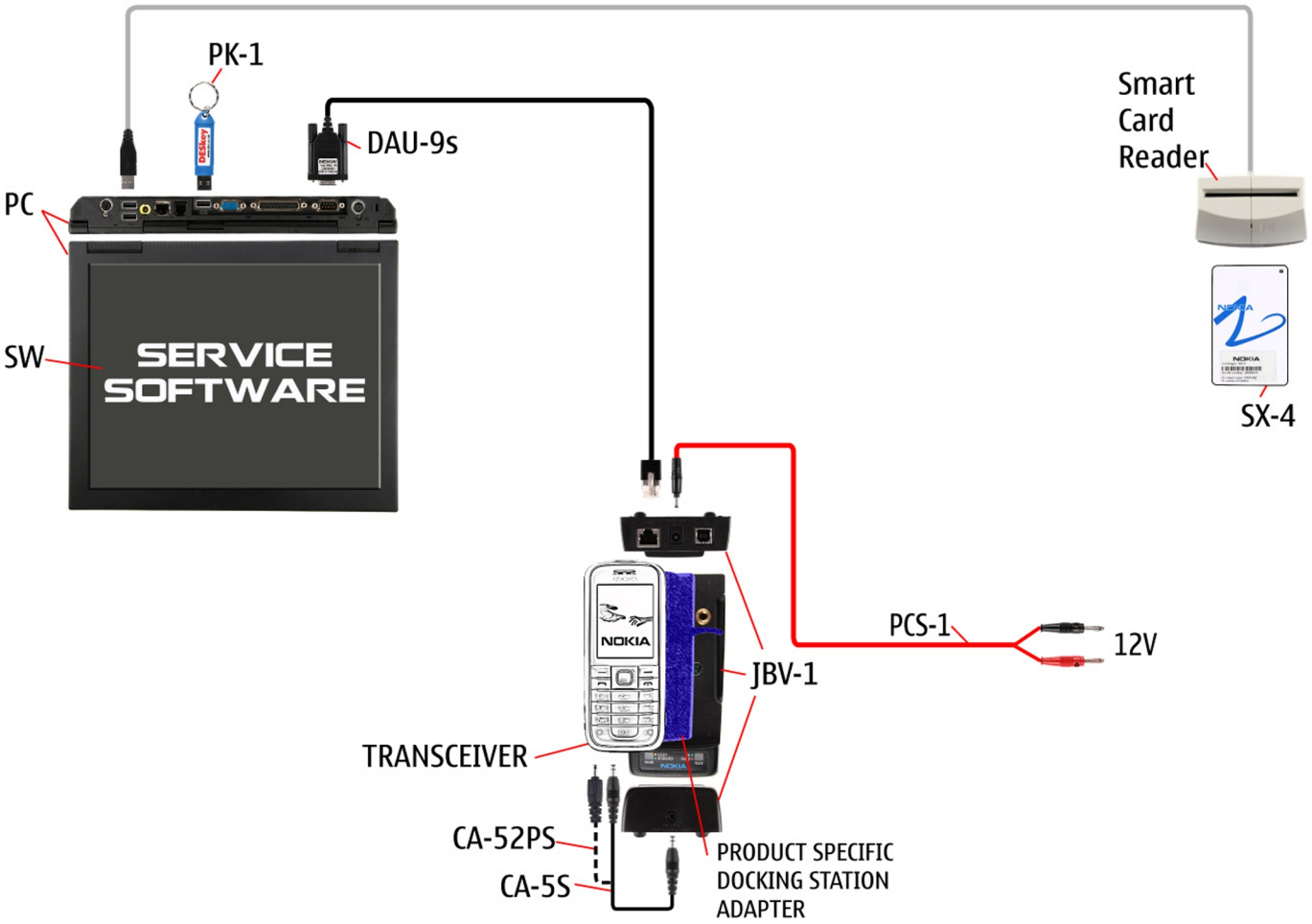



**Figure 6 EM calibration concept with JBV-1**


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## RF-test/BB-tune & flash concept with JBV-1, FPS-10

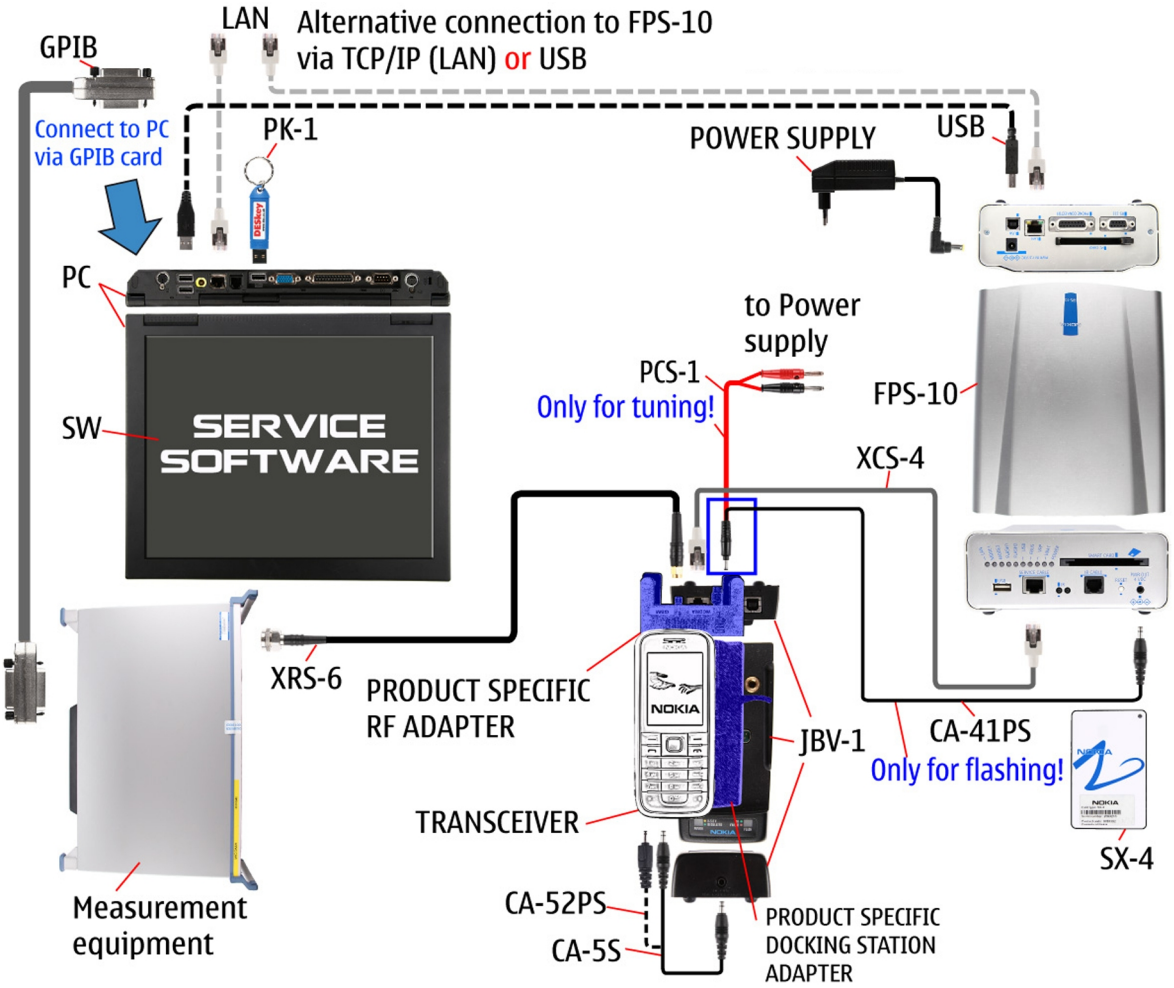



**Figure 7 RF-test/BB-tune & flash concept with JBV-1, FPS-10**


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## RF/BB tune& flash concept with MJ-137, FPS-10

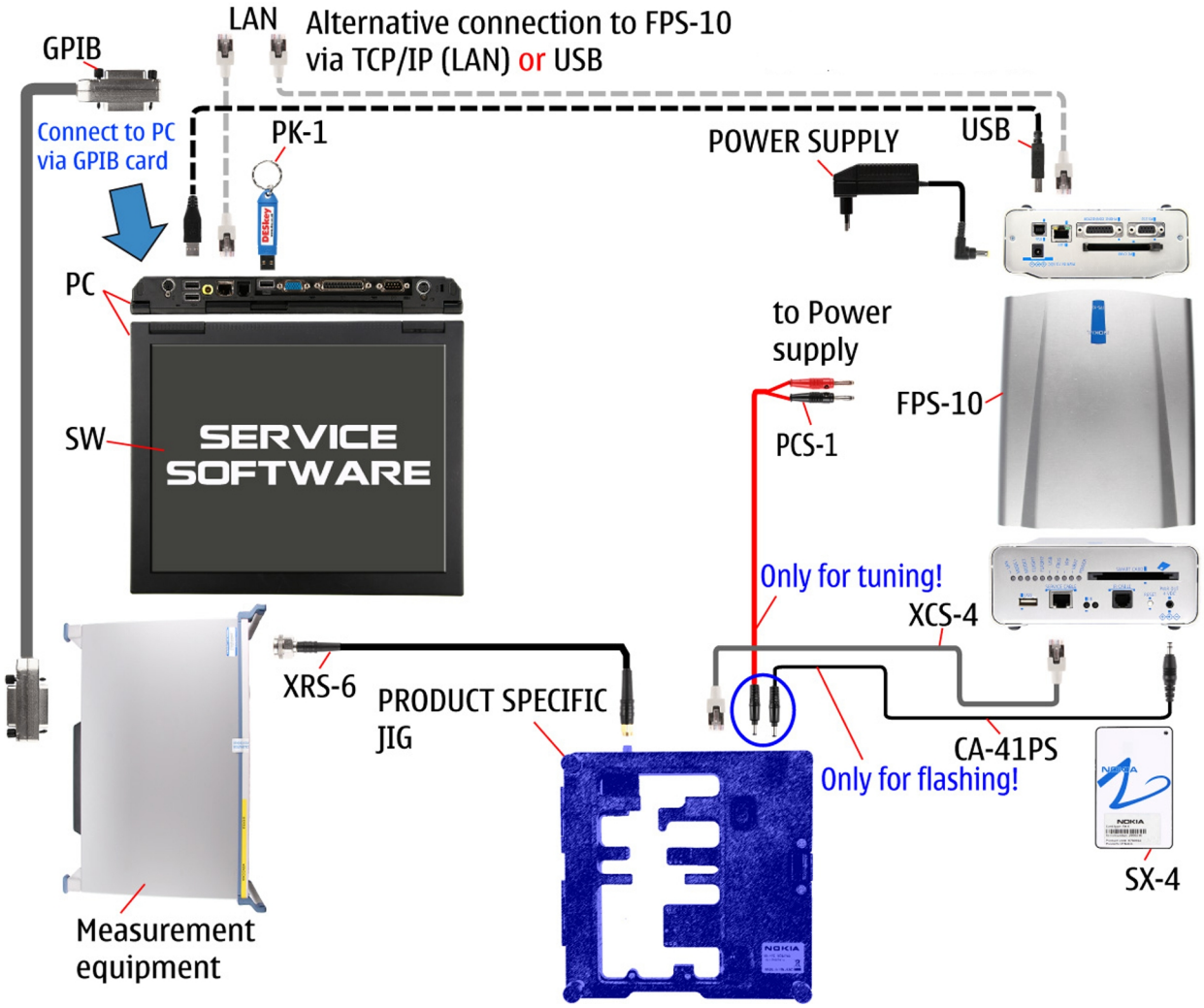



**Figure 8 RF/BB tune& flash concept with MJ-137, FPS-10**


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# 3 — Baseband Troubleshooting Instructions


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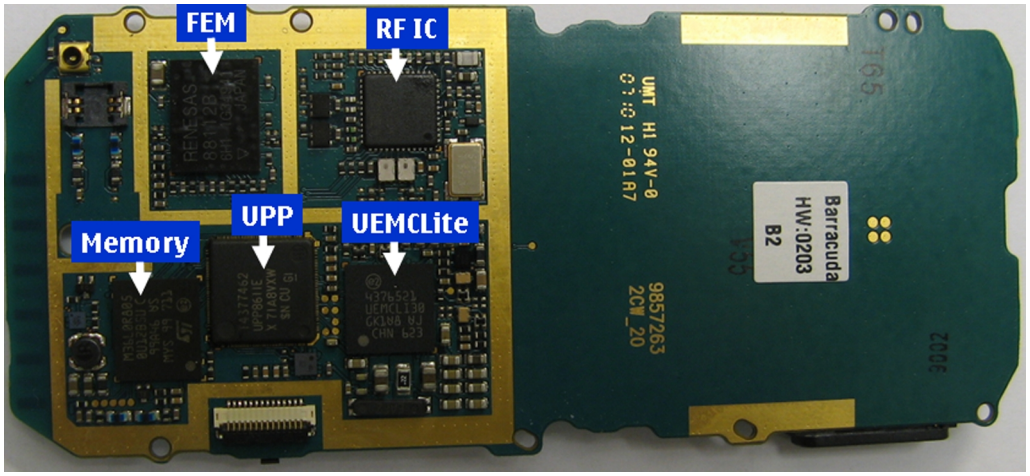

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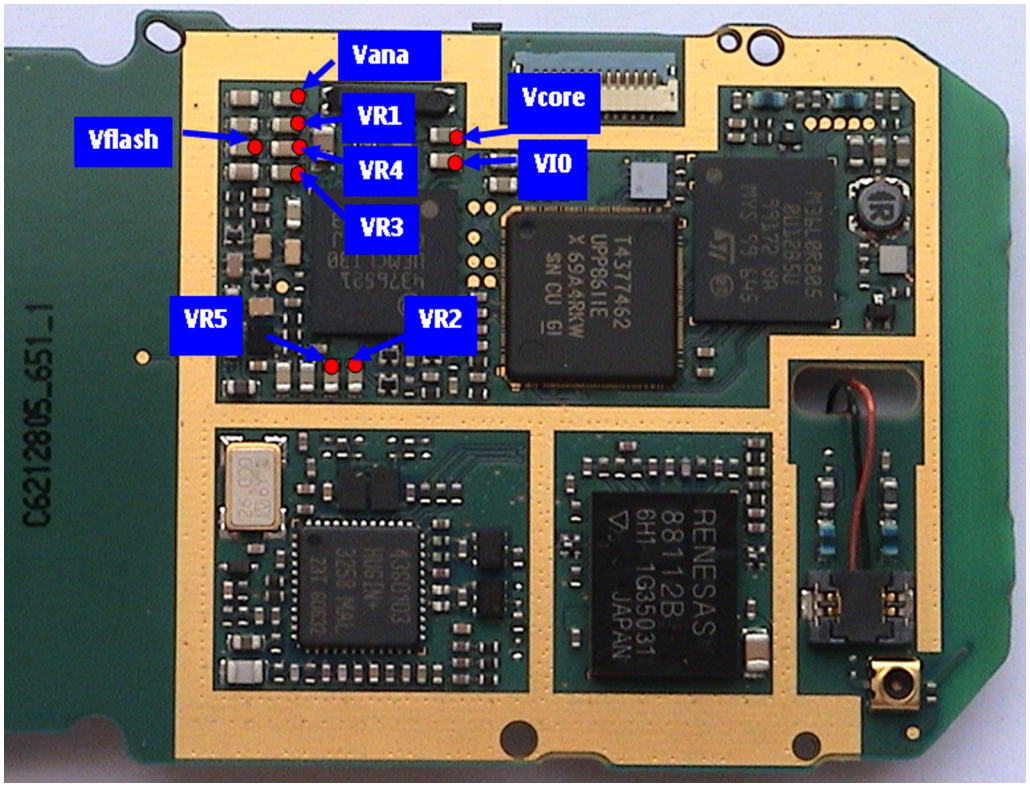

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# General baseband troubleshooting

## Key components




## Power supply test points




## Phone cannot be powered on (I)

### Context

This means that the phone does not use any current at all when the supply is connected and/or power key is pressed. It is assumed that the voltage supplied is 3.6VDC. The UEMCLite will prevent any functionality at battery/supply levels below 2.9VDC.


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## Troubleshooting flow

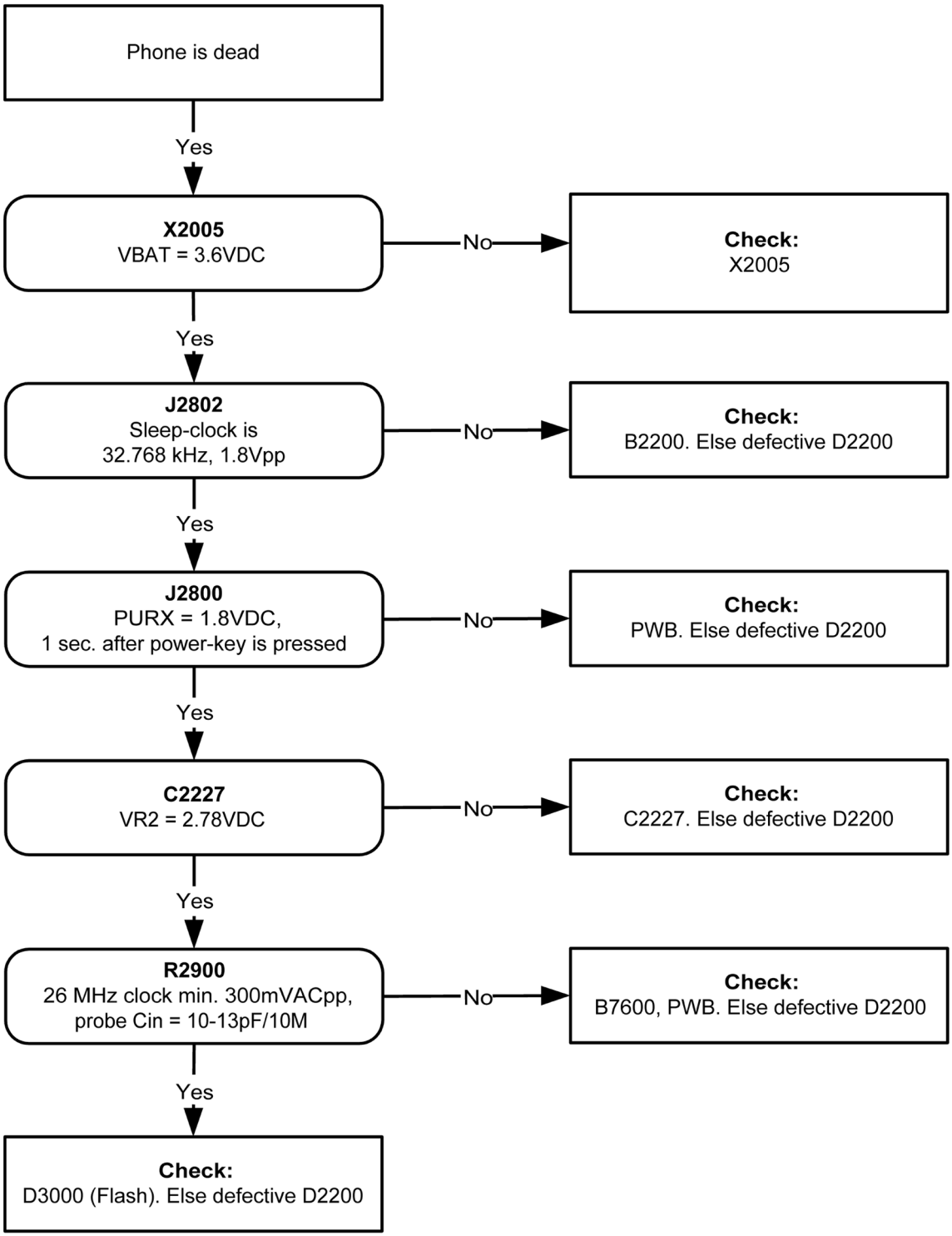



**Figure 9 Troubleshooting when phone cannot be powered on**


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## Phone cannot be powered on (II)

### Context

If this kind of failure is presenting itself immediately after FLALI, it is most likely caused by ASIC's missing contact with PWB.

If the MCU doesn't service the watchdog register within the UEMCLite, the operations watchdog will run out after approximately 32 seconds. Unfortunately, the service routine can not be measured.

### Troubleshooting flow

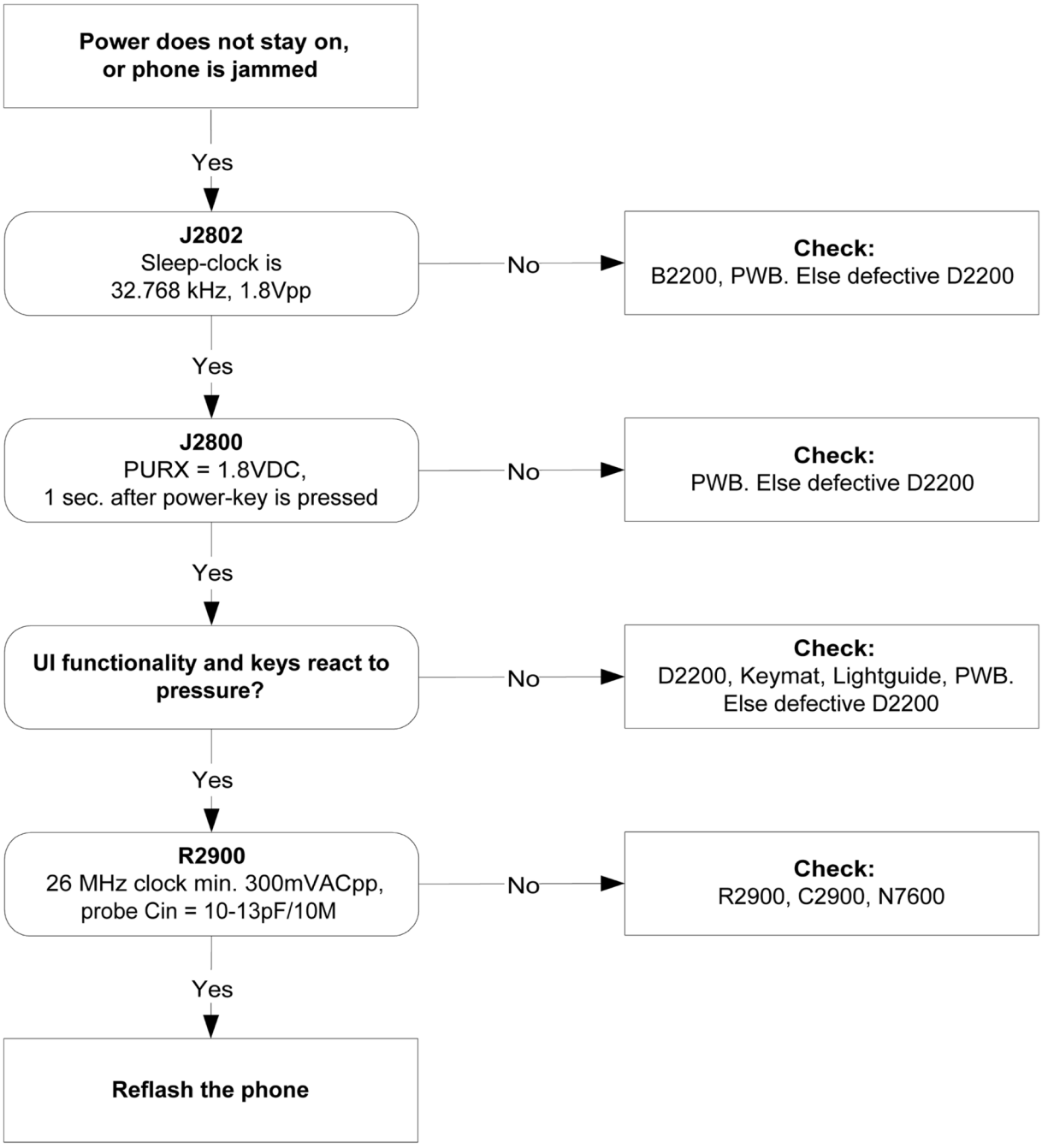



**Figure 10 Troubleshooting when phone does not stay on or phone is jammed**


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## Phone cannot be flashed

### Context

The flash programming can be done via the pads on the PWB (J2060). If failed, then follow up the trouble shooting flow chart.

In case of flash failure in the FLALI station, swap the phone and send it back to the care program for further analysis. Possible failures could be short-circuit of balls under µBGAs (UEMCLite, UPP4M, FLASH), or missing or misaligned components.

In flash programming error cases, the flash prommer can give some information about a fault. The fault information messages could be:

*Phone doesn't set FBUS_TX line low*

Because of the use of uBGA components, it is not possible to verify if there is a short circuit in the control and address lines of MCU (UPP8M) and the memory (flash).


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## Troubleshooting flow

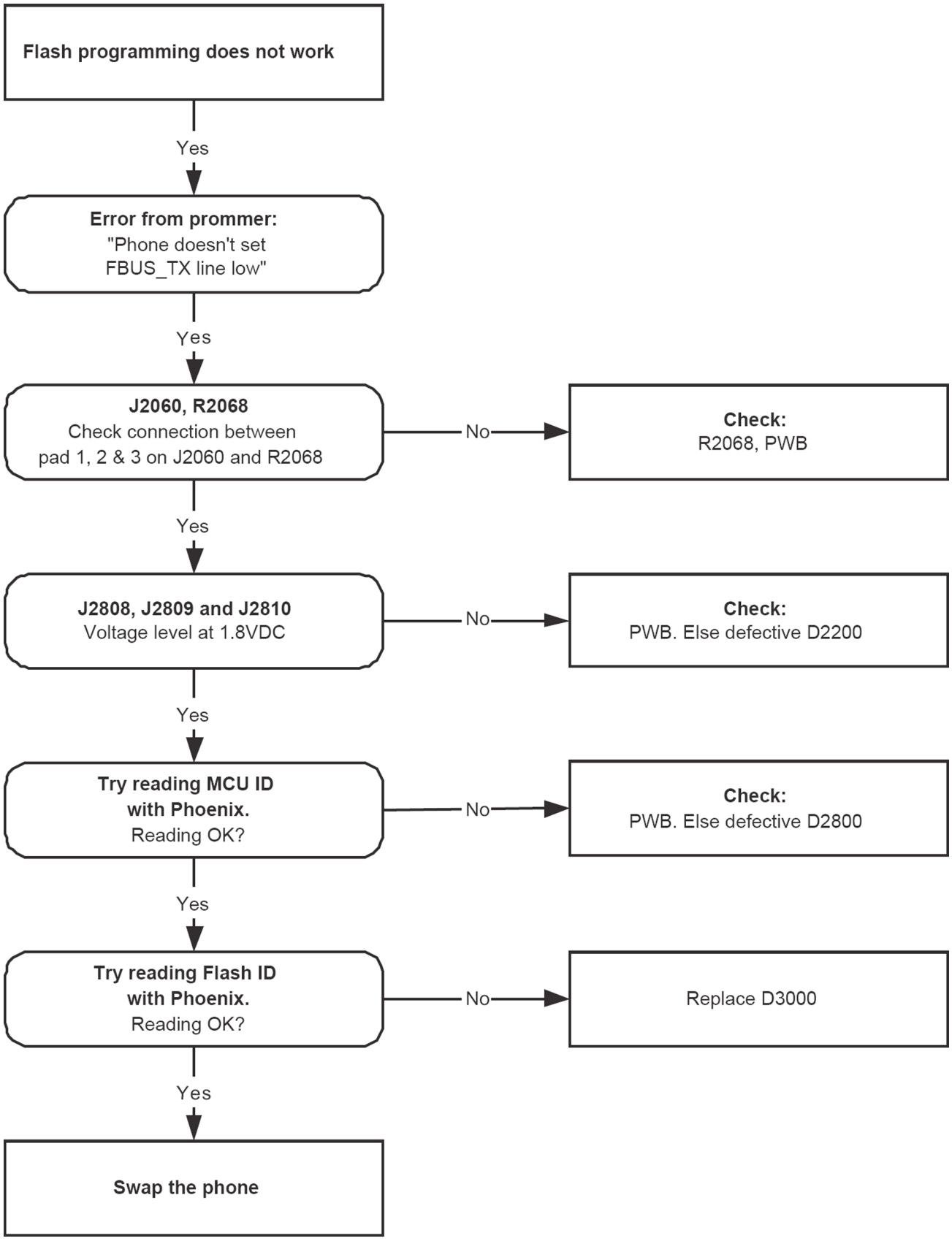



**Figure 11 Flash programming fault**


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## Easy flash programming does not work

### Context

The flash programming can be done via the easy flash connector. If failed, then follow up the trouble shooting below.

It is not possible to verify if there is a short circuit in control and address lines of MCU (UPP8M) and memory (flash) because BGA package is used in RM-298/299.


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## Troubleshooting flow

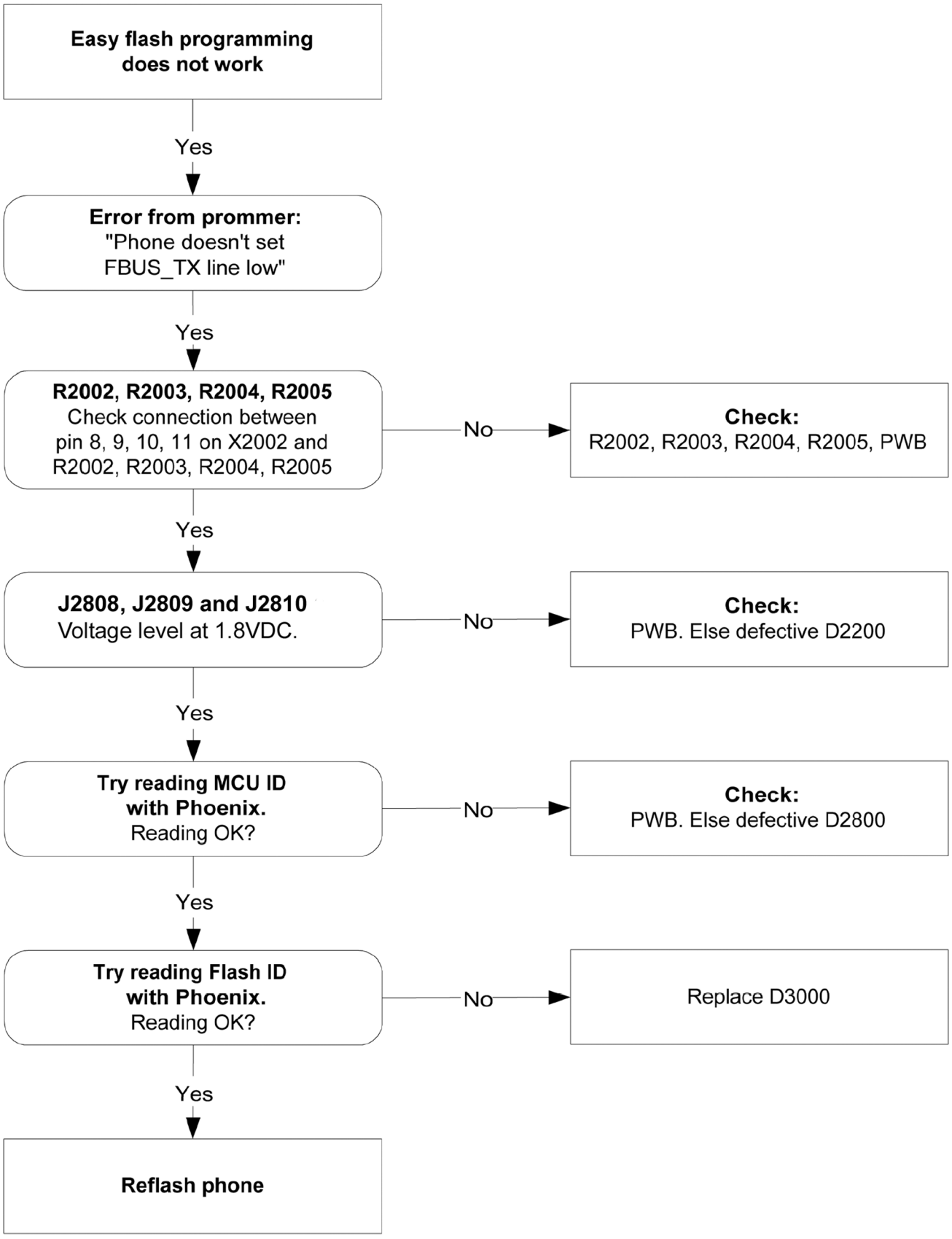



**Figure 12 Easy flash programming fault**


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## Display shows "Contact Service"

### Troubleshooting flow

This error can only happen at power up where several self-tests are run. If any of these test cases fails the display will show the message: "Contact Service".

They are individual test cases, so the below lineup of error hunting's has no chronological order. Use common sense and experience to decide which test case to start error hunting at.


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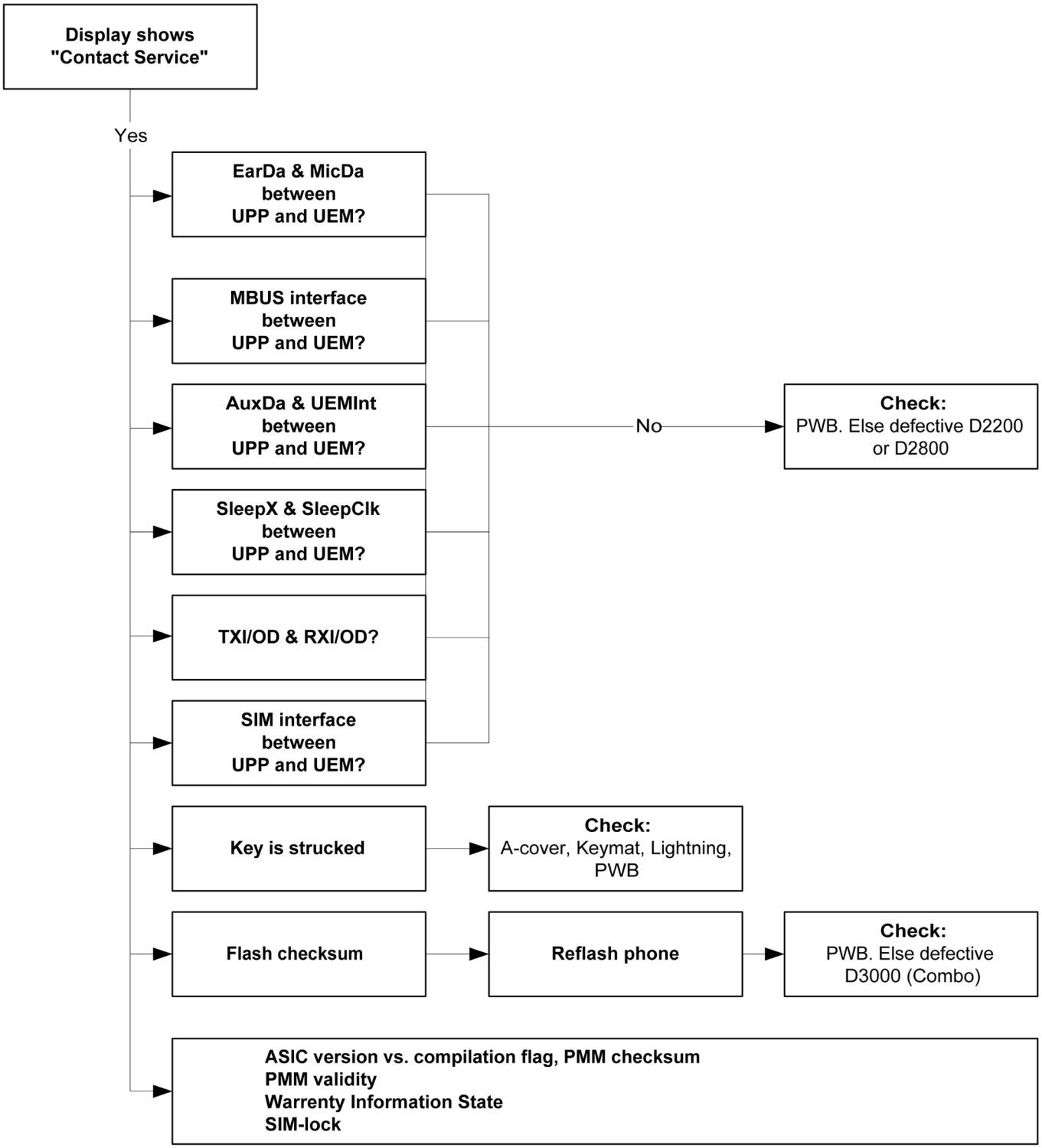



**Figure 13 Troubleshooting when the "Contact Service" message is seen**

## The phone does not register to the networks, or the phone cannot make a call

### Context

If the phone doesn't register to the network, the fault can be in either BB or RF. Only few signals can be tested since several signals are 'buried' in one or more of the inner layers of the PWB.

First, check that SIM LOCK is not causing the error by using a Test-SIM card and connect the phone to a tester.


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## Troubleshooting flow

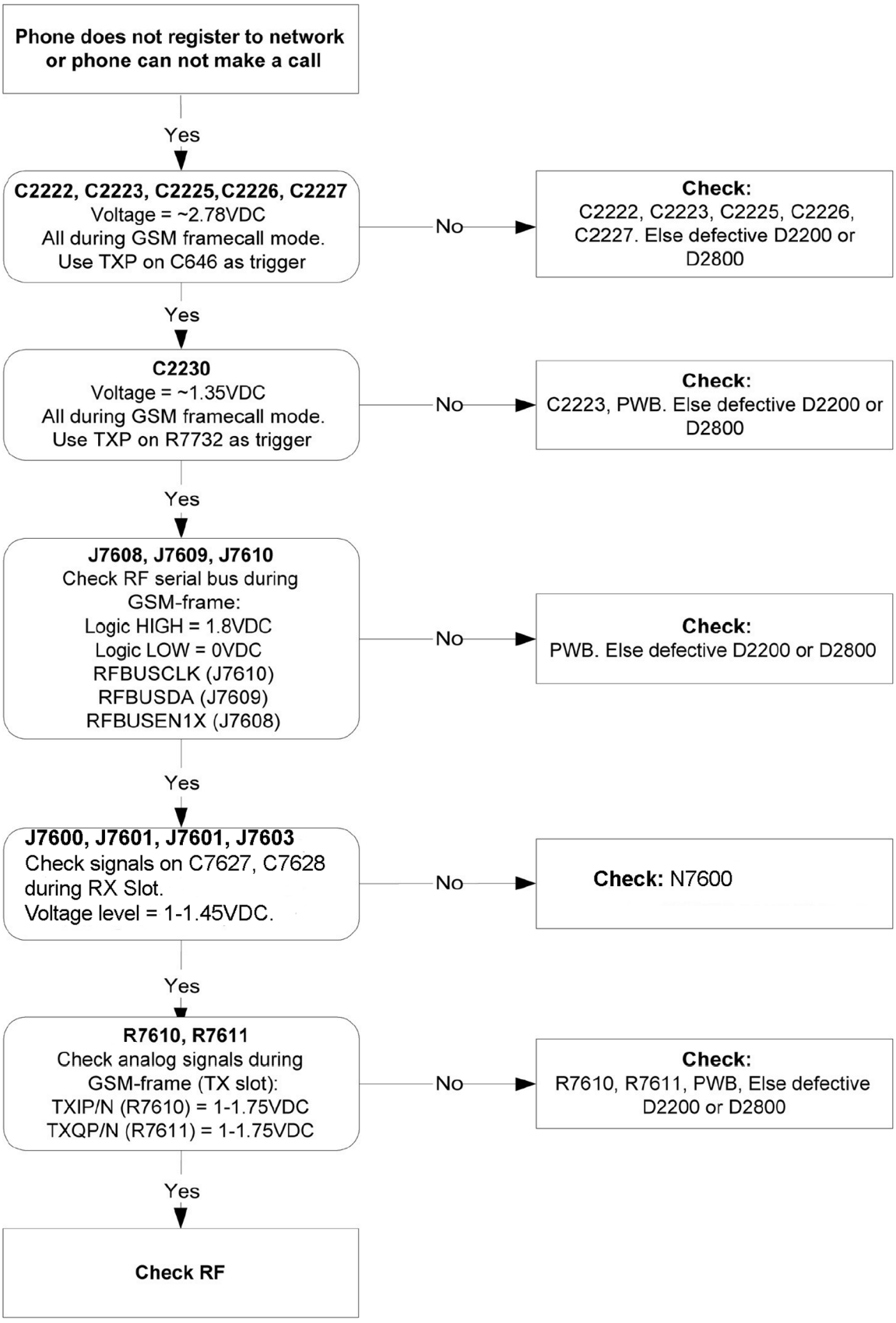



**Figure 14 No registering or call**


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## SIM related faults

### Insert SIM card fault

#### Troubleshooting flow

The hardware of the SIM interface from UEMCLite (D2200) to the SIM connector (X2700) can be tested without a SIM card. When the power is switched on the phone first check for a 1.8V SIM card and then a 3V SIM card. The phone will try this four times, where after it will display ”Insert SIM card”.

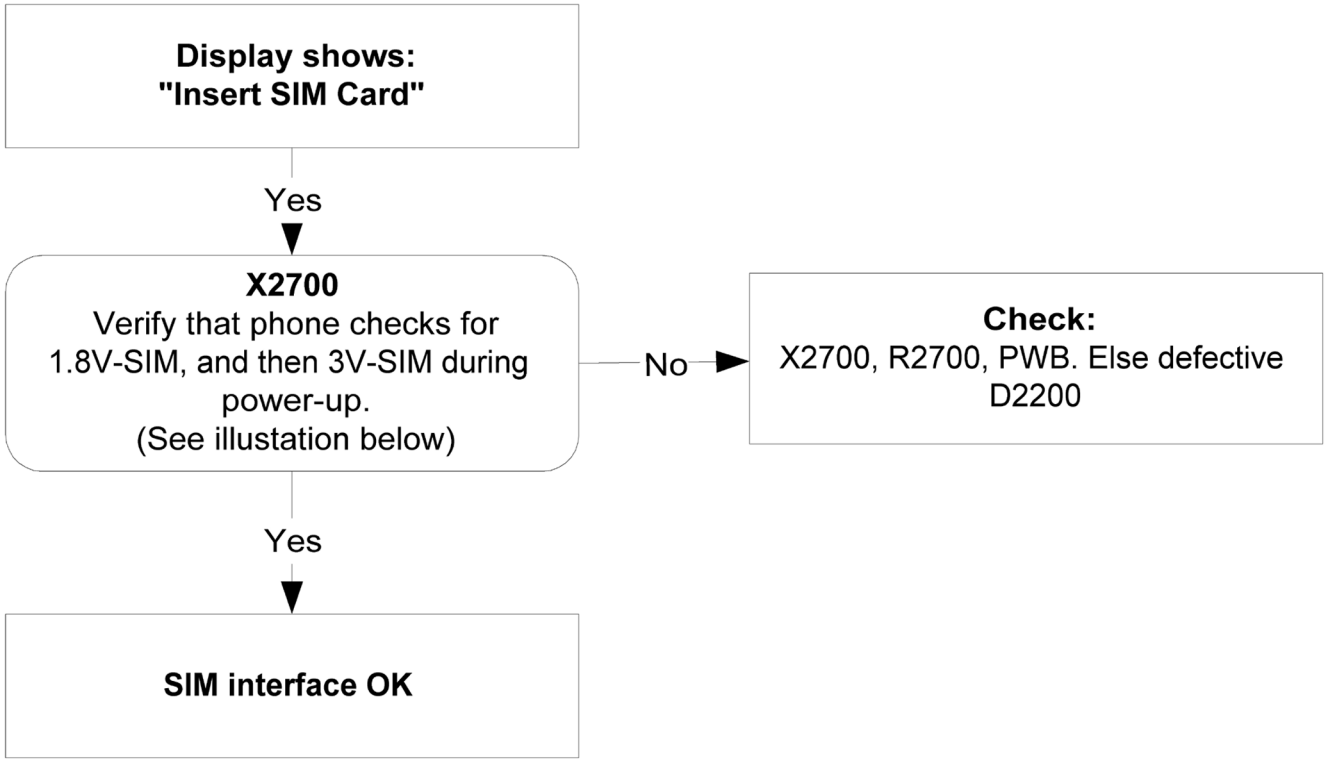



**Figure 15 Insert SIM card fault**


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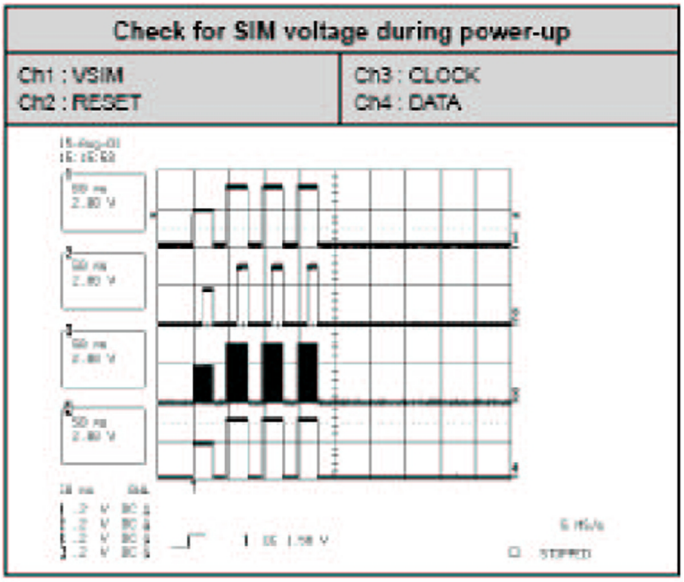



**Figure 16 Signal diagram**

## SIM card rejected

The error "SIM card rejected" means that the ATR message received from SIM card is corrupted, e.g. data signal levels are wrong. The first data is always ATR and it is sent from card to phone.

For reference a picture with normal SIM power-up is shown below.

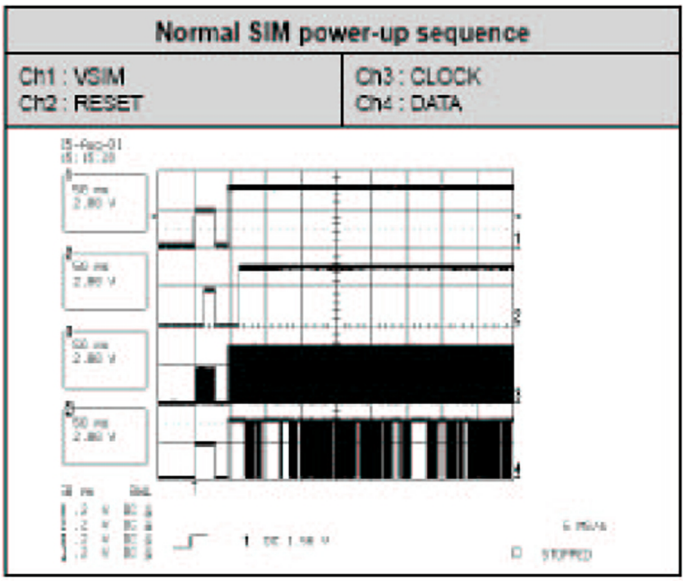



**Figure 17 Signal diagram**

# User interface

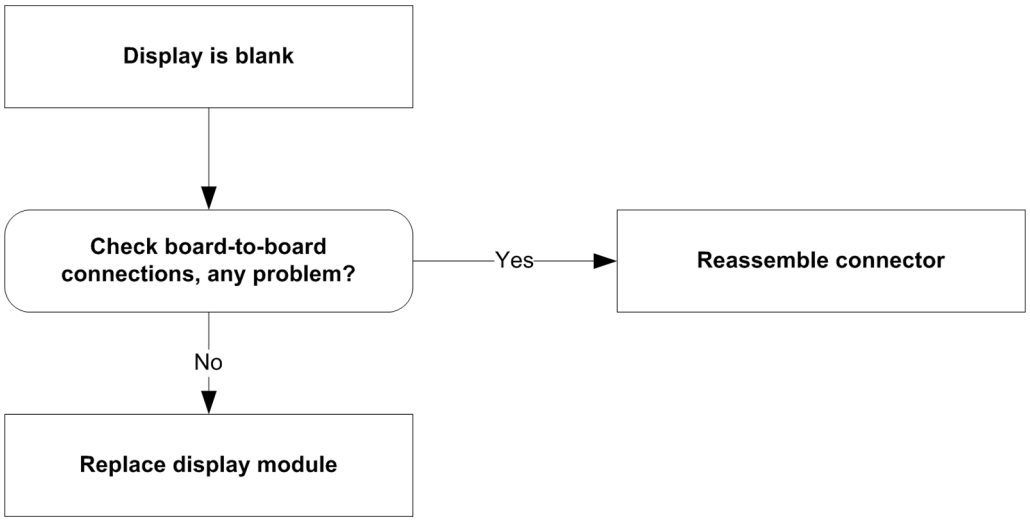
## Blank display

### Context

The display does not show any information at all. If there is only main or sub display blank, the problem mostly exists in individual display. Replace related display first. For main and sub display blank, refer to troubleshooting flow below.


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## Troubleshooting flow

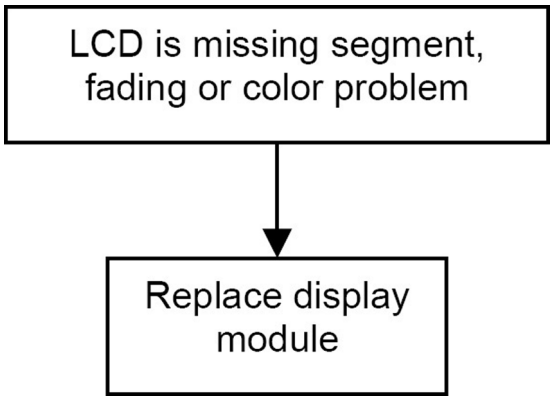



## Corrupted display

### Context

The display contains missing or fading segments, or color presentation is incorrect.

### Troubleshooting flow



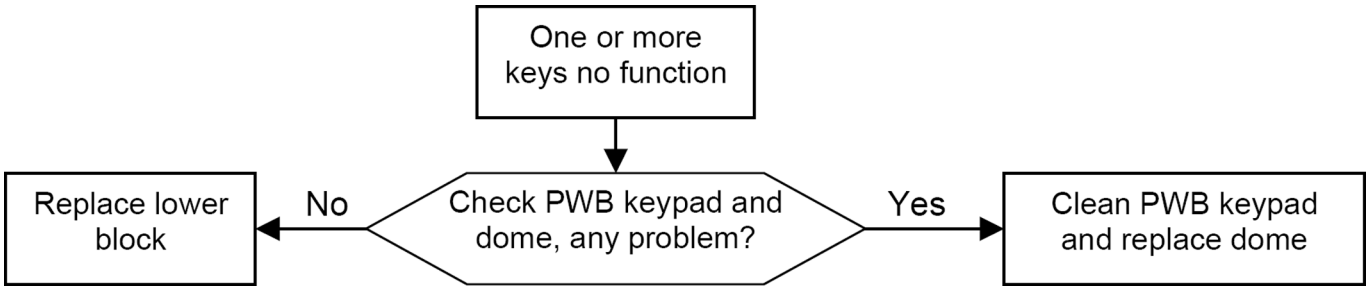

## Dead keys

### Context

One or more keys has no function.


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## Troubleshooting flow

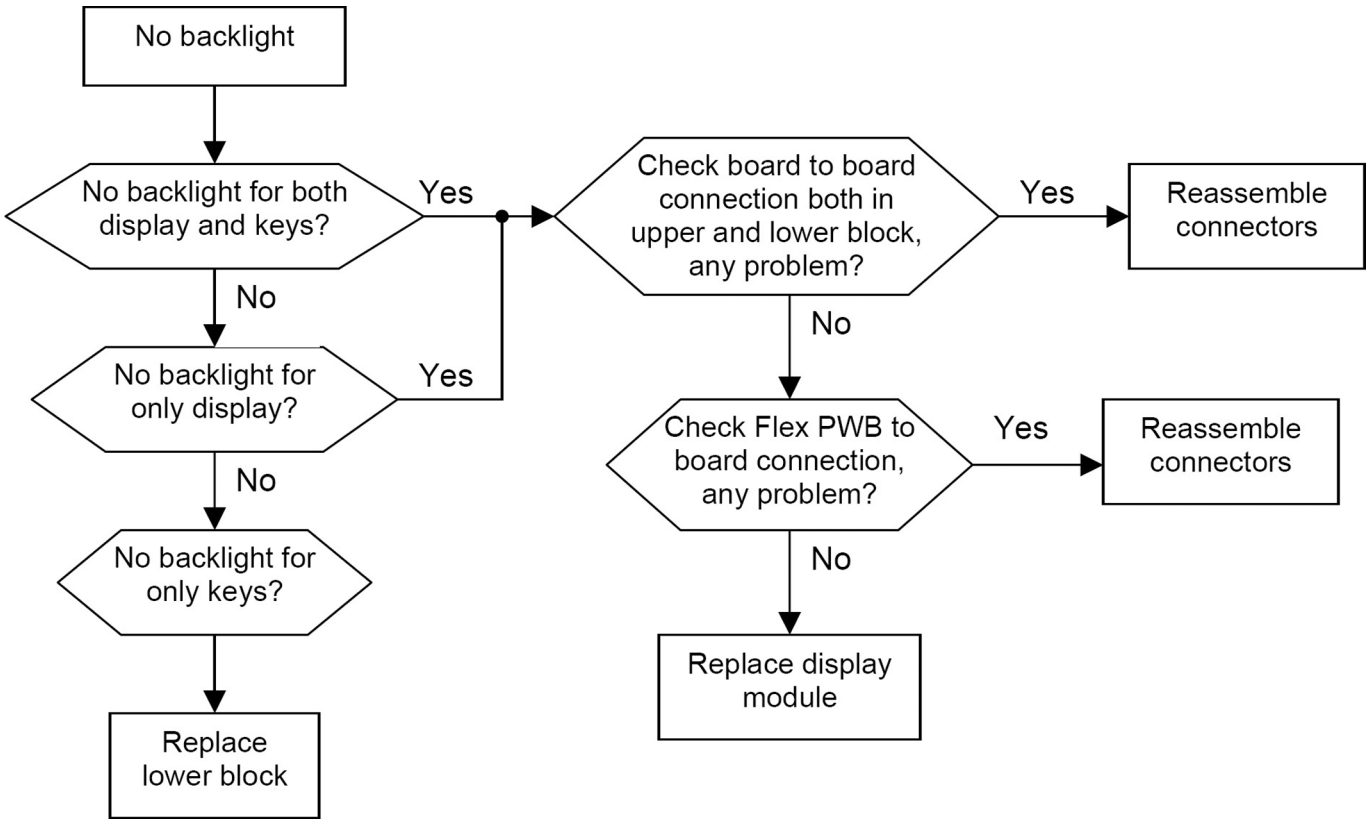



## No backlight for display or/and keys

### Context

There are 3 kinds of statuses: No backlight for both display and keys; No backlight for only display; No backlight for only keys.

### Troubleshooting flow





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## Audio troubleshooting

### Audio troubleshooting using phoenix

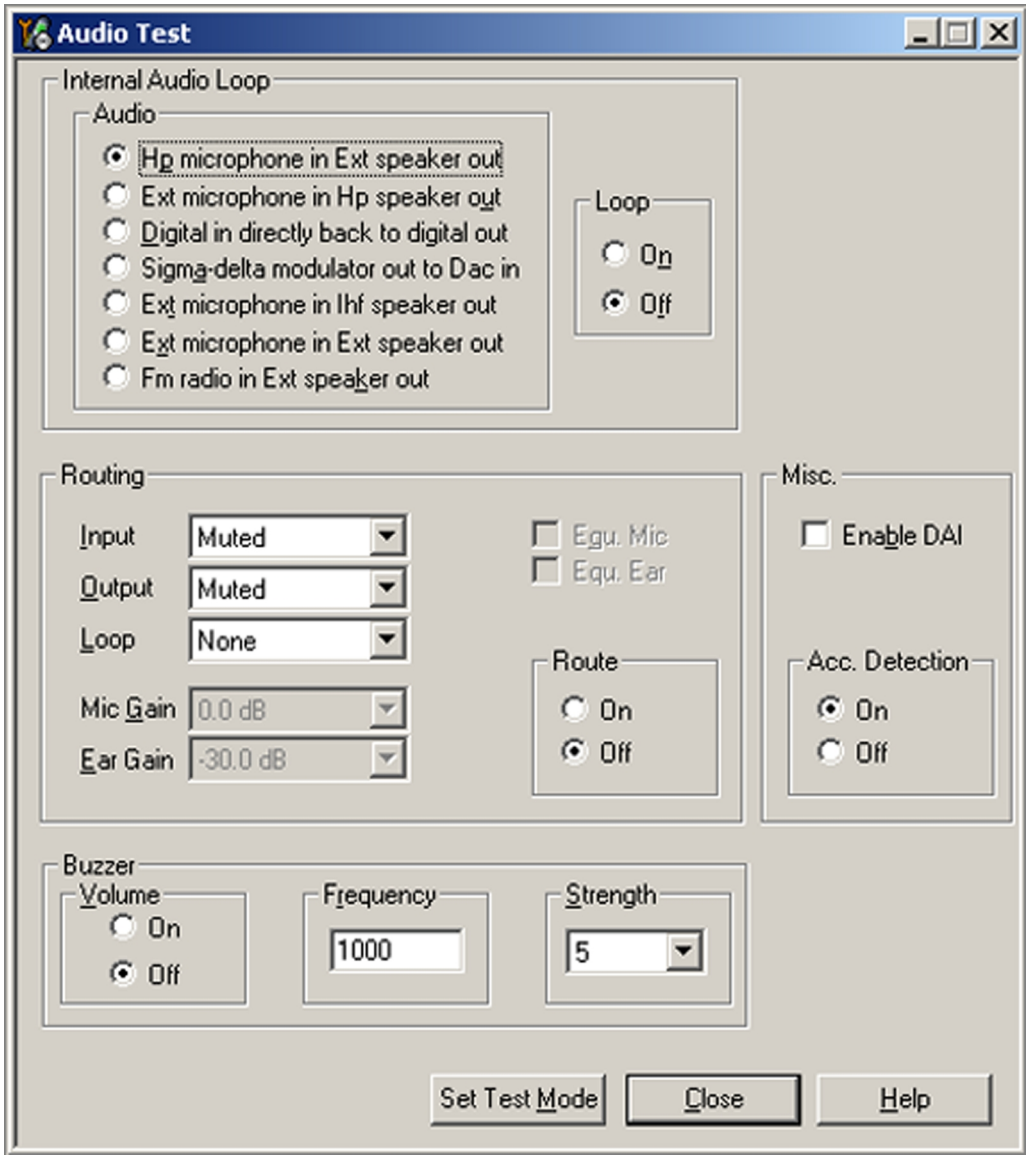



**Figure 18 Phoenix audio test window**


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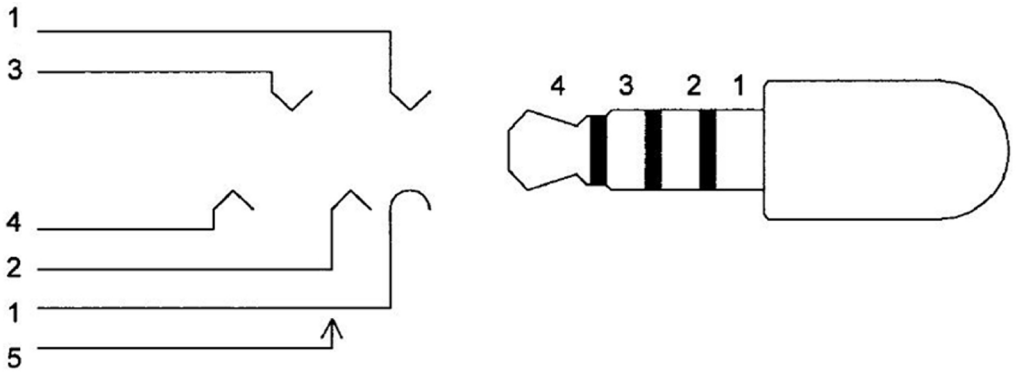



**Figure 19 4-pole jack plug for audio accessory**

**Table 6 Connector for External Audio Accessories**

| Pin | Signal name | Direction | Description |
|---|---|---|---|
| 5 | PLUGDET | Input | Terminal internal connection, plug detection |
| 4 | HS EAR L | Output | Audio output |
| 3 | HS EAR R | Output | Audio output |
| 2 | HS MIC | Input | Multiplexed microphone audio and control data |
| 1 | HS GND | - | Ground contact |

## Check microphone using "Hp microphone in Ext speaker out" loop

### Steps

1. Connect phone with Phoenix.
2. Open “audio test” window from “Testing -> Audio test”, as shown in *Figure Phoenix audio test window* above.
3. Select “Hp microphone in Ext speaker out”
4. Select "Acc. Detection" as "Off".
5. Select “Loop” as “On”
6. Input sound at microphone port, for example 94dB SPL 1kHz.


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7. Check if signal is detected at HS EAR L/R, shown in *Figure 4-pole jack plug for audio accessory* above.

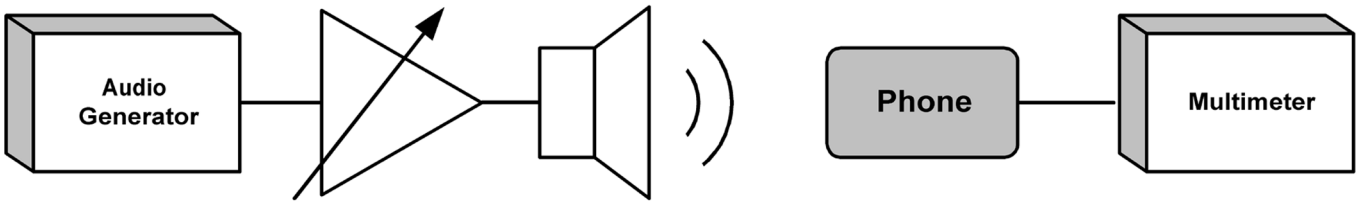



**Figure 20 Test arrangement for microphone**

## Check earpiece using "Ext microphone in Hp speaker out" loop

### Steps

1. Connect phone with Phoenix.
2. Open the *Audio Test* window from **Testing→ Audio test** , as shown in Figure *Phoenix audio test window* above.
3. Select **Ext microphone in Hp speaker out**.
4. Select **Acc.Detection** as **Off**.
5. Select **Loop** as **On**.
6. Input signal to HS MIC, as shown in Figure *4-pole jack plug for audio accessory* above, for example 100mVpp, 1kHz.
7. Check if sound is heard in the earpiece.




**Figure 21 Test arrangement for of earpiece**

## Check IHF & ringing tone function using "Buzzer"

### Steps

1. Connect phone with Phoenix.
2. Open “audio test” window from “Testing -> Audio test”, as shown in *Figure Phoenix audio test window* above.
3. In “Buzzer” area, select suitable signal to be played, for example 1 kHz, Strength 5”
4. Select “Volume” as “On”


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5. Check if sound is heard in IHF.

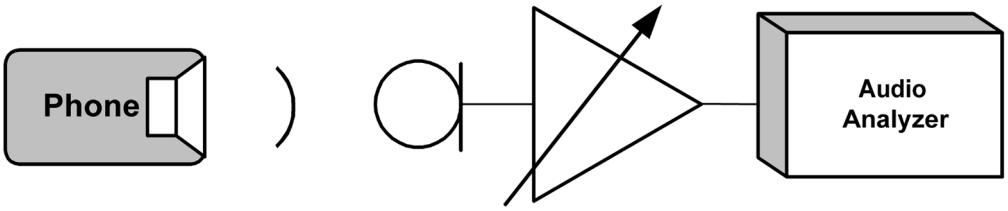



**Figure 22 Checking IHF and ring tone by using "Buzzer"**

## Check vibra function using "Vibra control"

### Steps

1. Connect phone with Phoenix.
2. Open “Vibra control” window from “Testing -> Vibra control”, as shown in the figure below.
3. Select suitable intensity value, for example 53 %.
4. Select “Vibra state” as “Enabled”
5. Click “Write”.
6. Check if Vibra works.

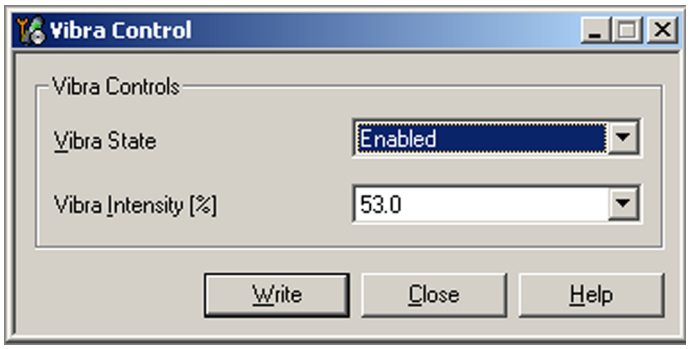



**Figure 23 Checking vibra function by using vibra control**


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## Earpiece fault

### Troubleshooting flow

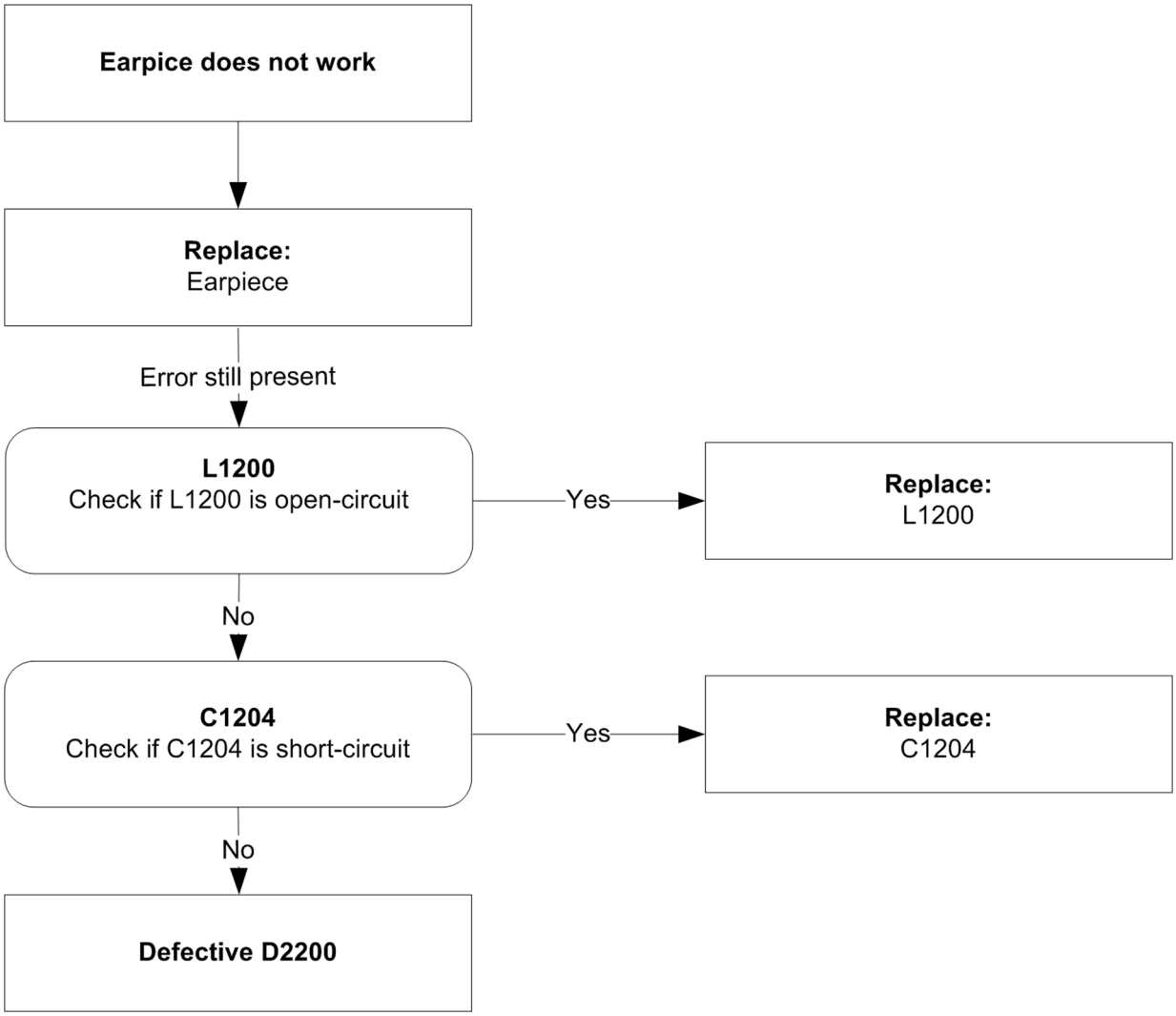



**Figure 24 Earpiece fault flow chart**


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## IHF/ringing tone fault

### Troubleshooting flow

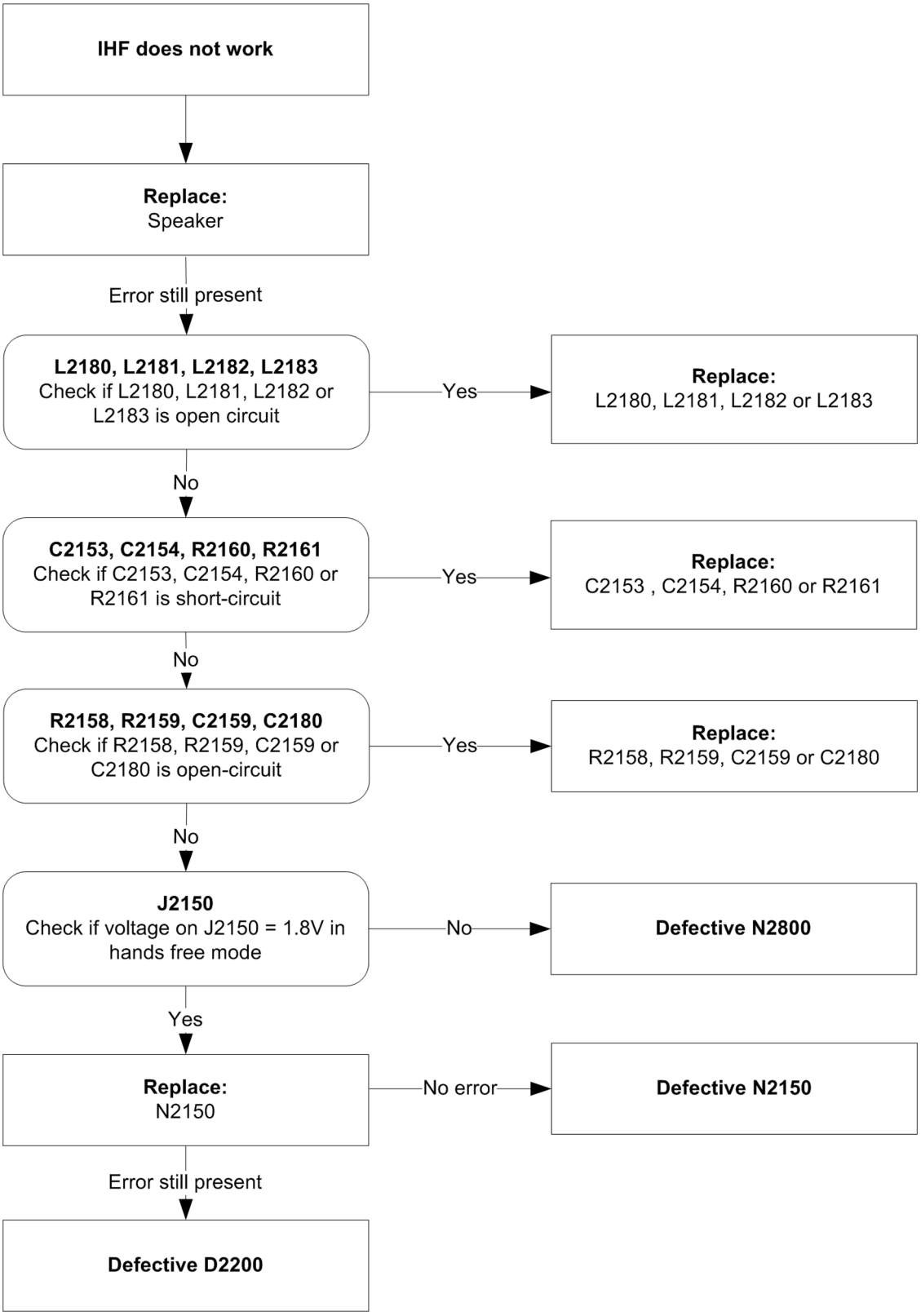



**Figure 25 IHF/ringing tone fault flow chart**


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## Microphone fault

### Troubleshooting flow

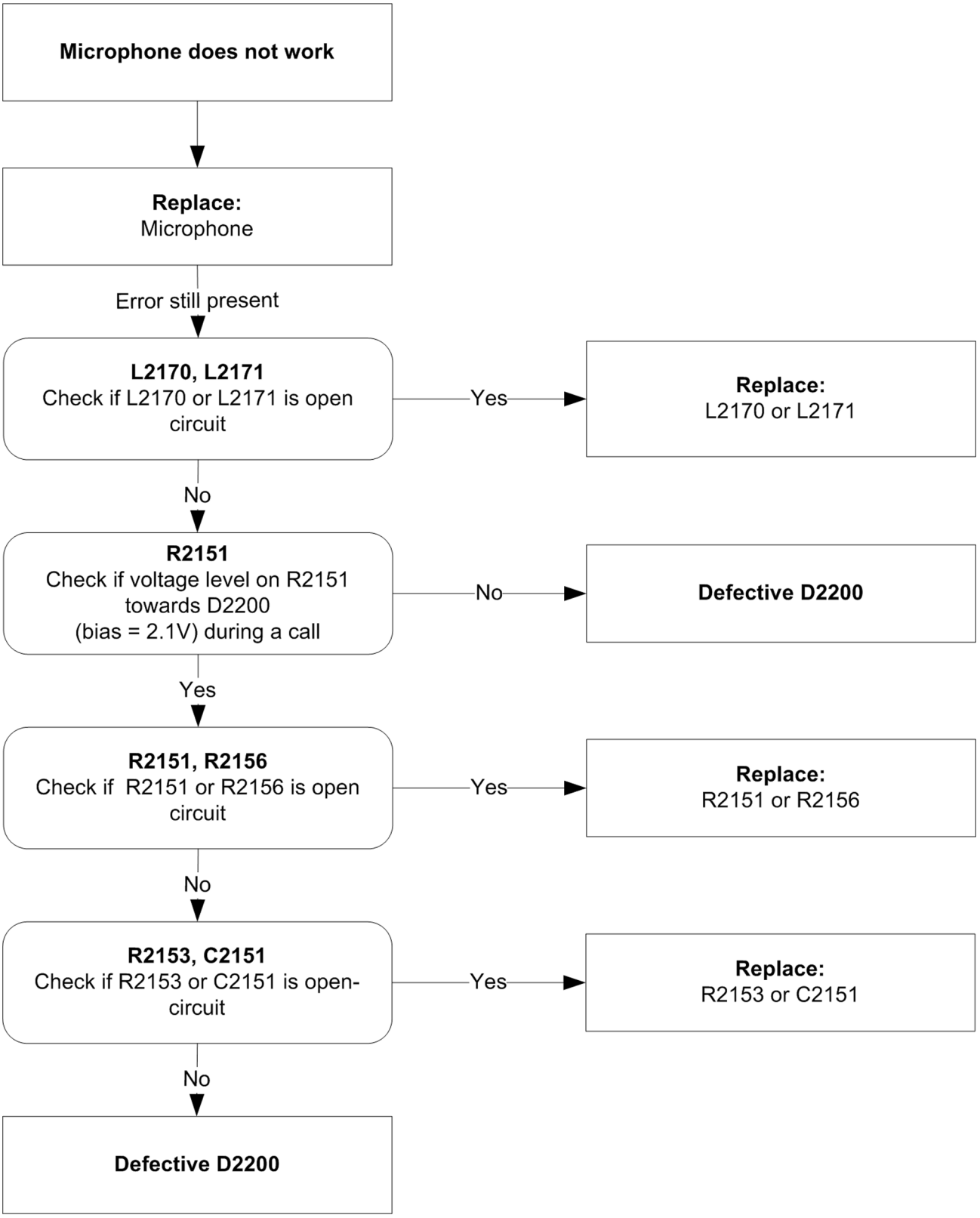



**Figure 26 Microphone fault flow chart**


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## Headset earpiece fault

### Troubleshooting flow

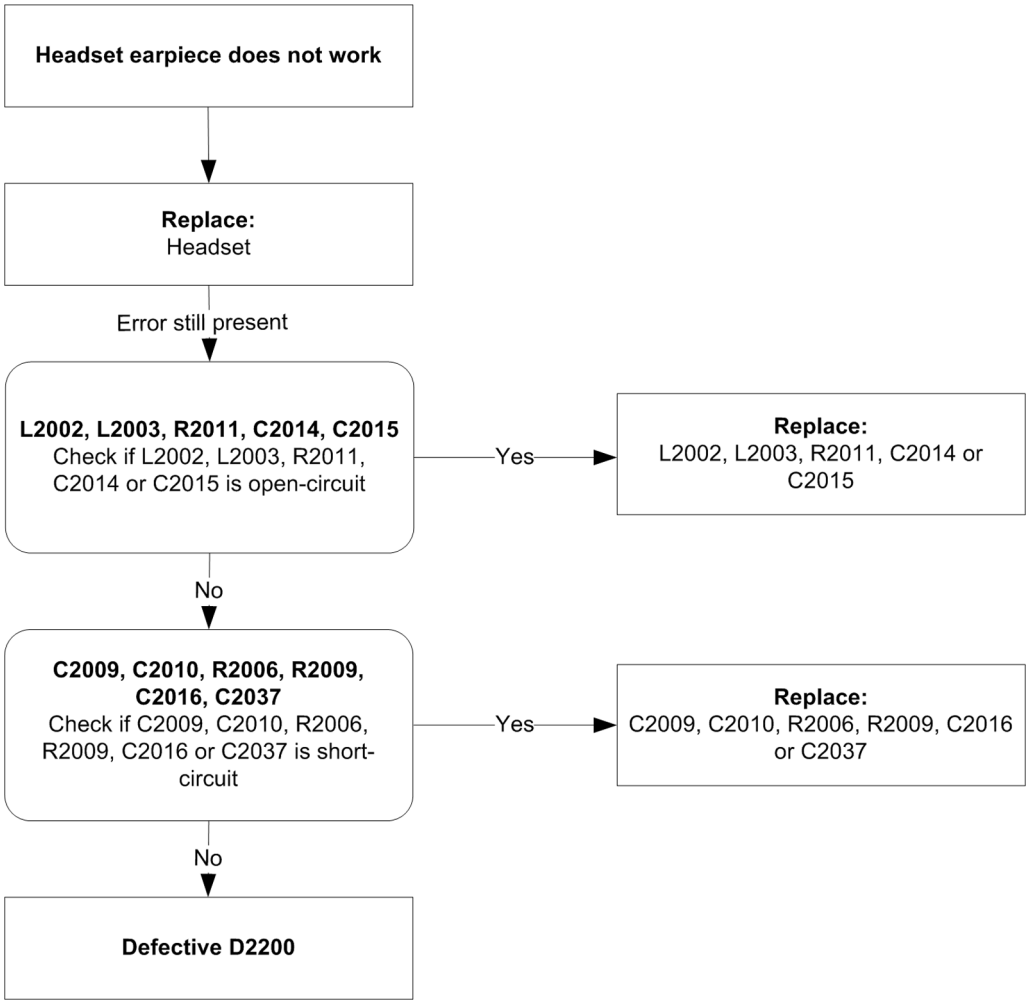



**Figure 27 Headset earpiece fault flow chart**


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## Headset microphone fault

### Troubleshooting flow

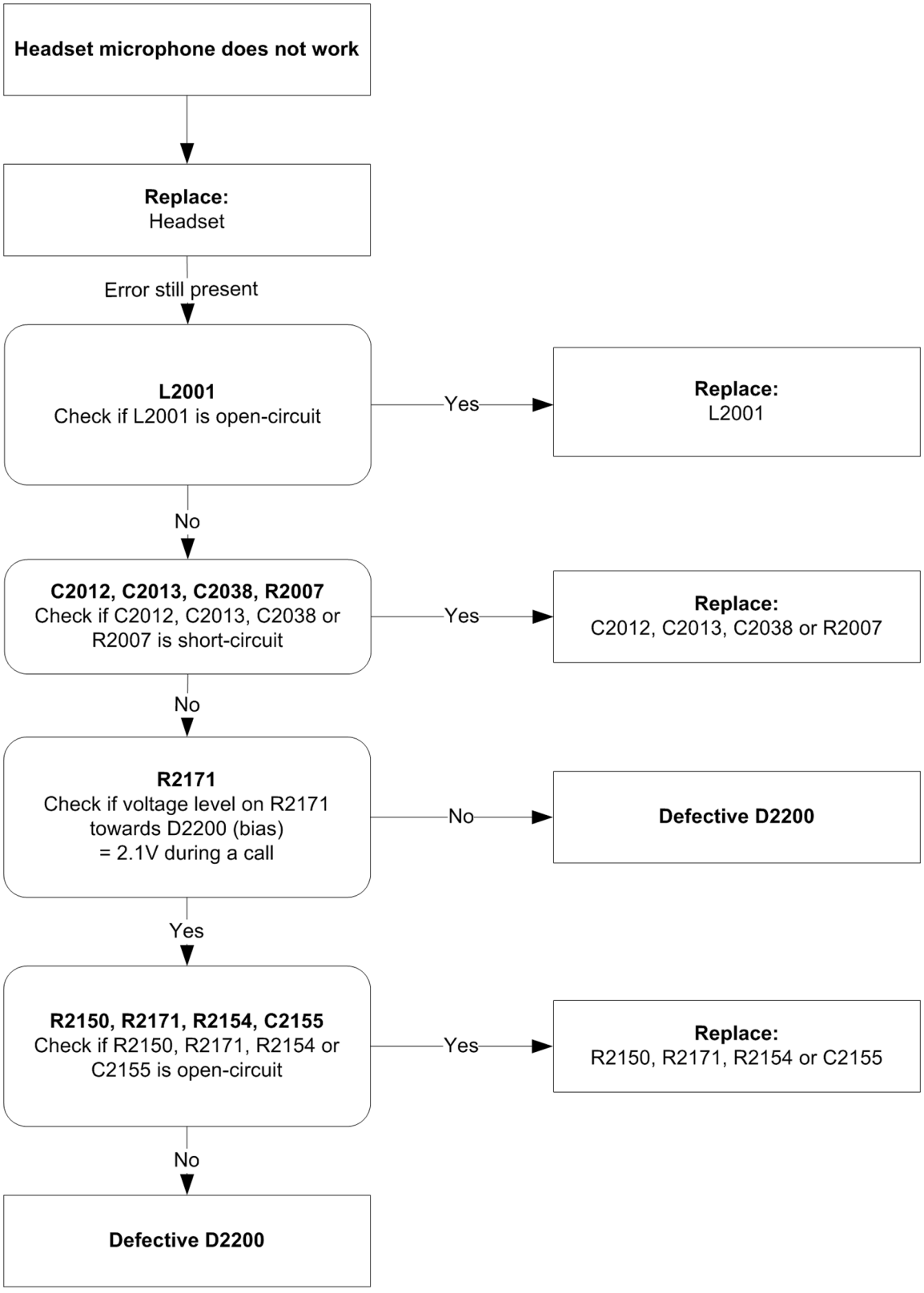



**Figure 28 Headset microphone fault flow chart**


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# 4 — RF Troubleshooting Instructions


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# General RF troubleshooting

## General RF troubleshooting

### Most RF semiconductors are static discharge sensitive

Two types of measurements are used in the following. It will be specified if the measurement type is "RF" or "LF".

- RF measurements are done with a Spectrum Analyzer and a high-frequency 500 ohm passive probe, for example HP54006A. (Note that when measuring with the 500ohm probe the signal will be around 20dB attenuated. The values in the following will have these 20dB subtracted and represent the real value seen on the spectrum analyzer). Note that the testing have some losses which must be taken into consideration when calibrating the test system.
- LF (Low frequency) and DC measurements should be done with a 10:1 probe and an oscilloscope. The probe used in the following is 10Mohm/8pF passive probe. If using another probe then bear in mind that the voltages displayed may be slightly different. Always make sure the measurement set-up is calibrated when measuring RF parameters on the antenna pad. Remember to include the loss in the module repair jig when realigning the phone.

So ESD protection must be applied during repair (ground straps and ESD soldering irons). Mjoelner and Bifrost are moisture sensitive so parts must be pre-baked prior to soldering. Apart from key-components described in this document there are a lot of discrete components (resistors, inductors and capacitors) for which troubleshooting is done by checking if soldering of the component is done properly and checking if the component is missing from PWB. Capacitors can be checked for short-circuiting and resistors for value by means of an ohmmeter, but be aware in-circuit measurements should be evaluated carefully. In the following both the name EGSM and GSM850 will be used for the lower band and both PCN and GSM1900 will be used for the upper band.

## RF key components

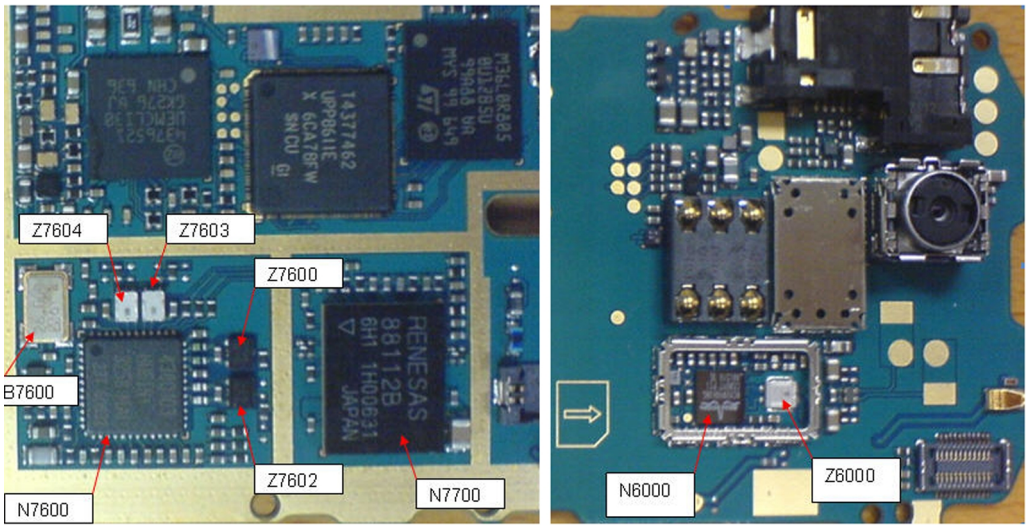



**Figure 29 RF key components on PWB**

| | |
|---|---|
| N7600 | PMB3258 RF IC |
| N7700 | FEM (PA and antenna switch) |
| Z7602 | EGSM 850/900 RX SAW filter |
| Z7600 | DCS 1800/PCS1900 RX SAW filter |


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| | |
|---|---|
| Z7603 | EGSM 850/900 TX filter |
| Z7604 | DCS 1800/PCS1900 TX filter |
| B7600 | 26 MHz crystal |
| N6000 | BT & FM IC |
| Z6000 | BT SAW filter |

Refer to the picture below for measuring points at the UEM (D2200).

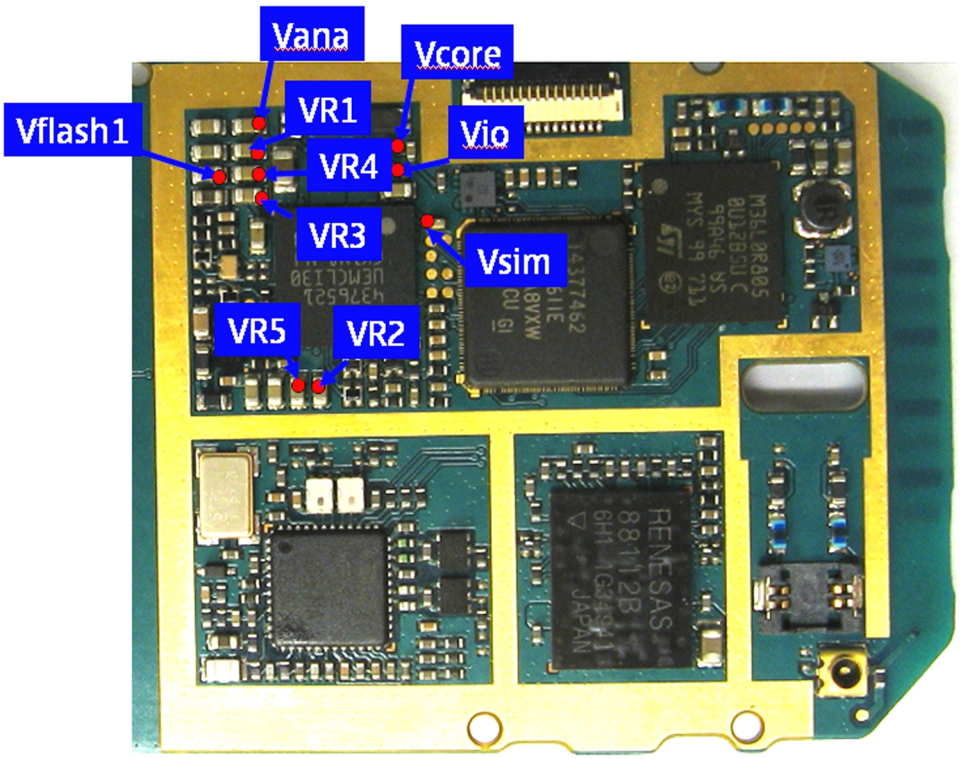



**Figure 30 Supply points at UEM (D2200)**


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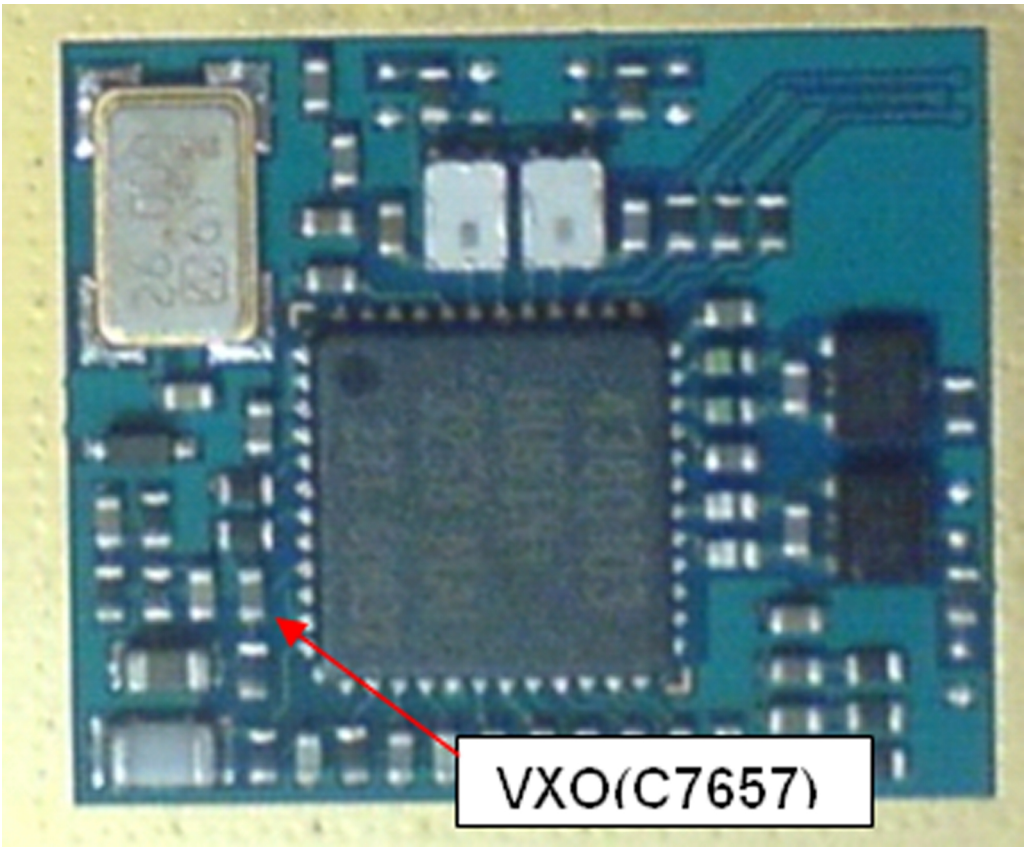



**Figure 31 Supply point at RF IC (N7600)**

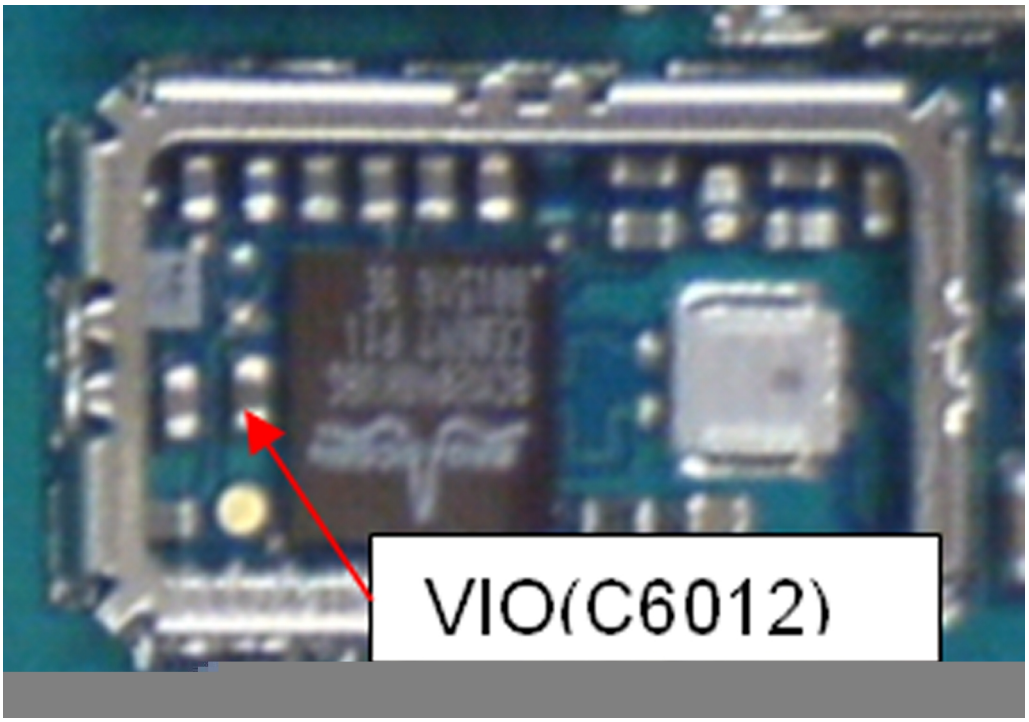



**Figure 32 Supply point at BT & FM IC (N6000)**

## Auto tuning

This phone can be tuned automatically.


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## Troubleshooting diagram for GSM900 transmitter

### Troubleshooting flow

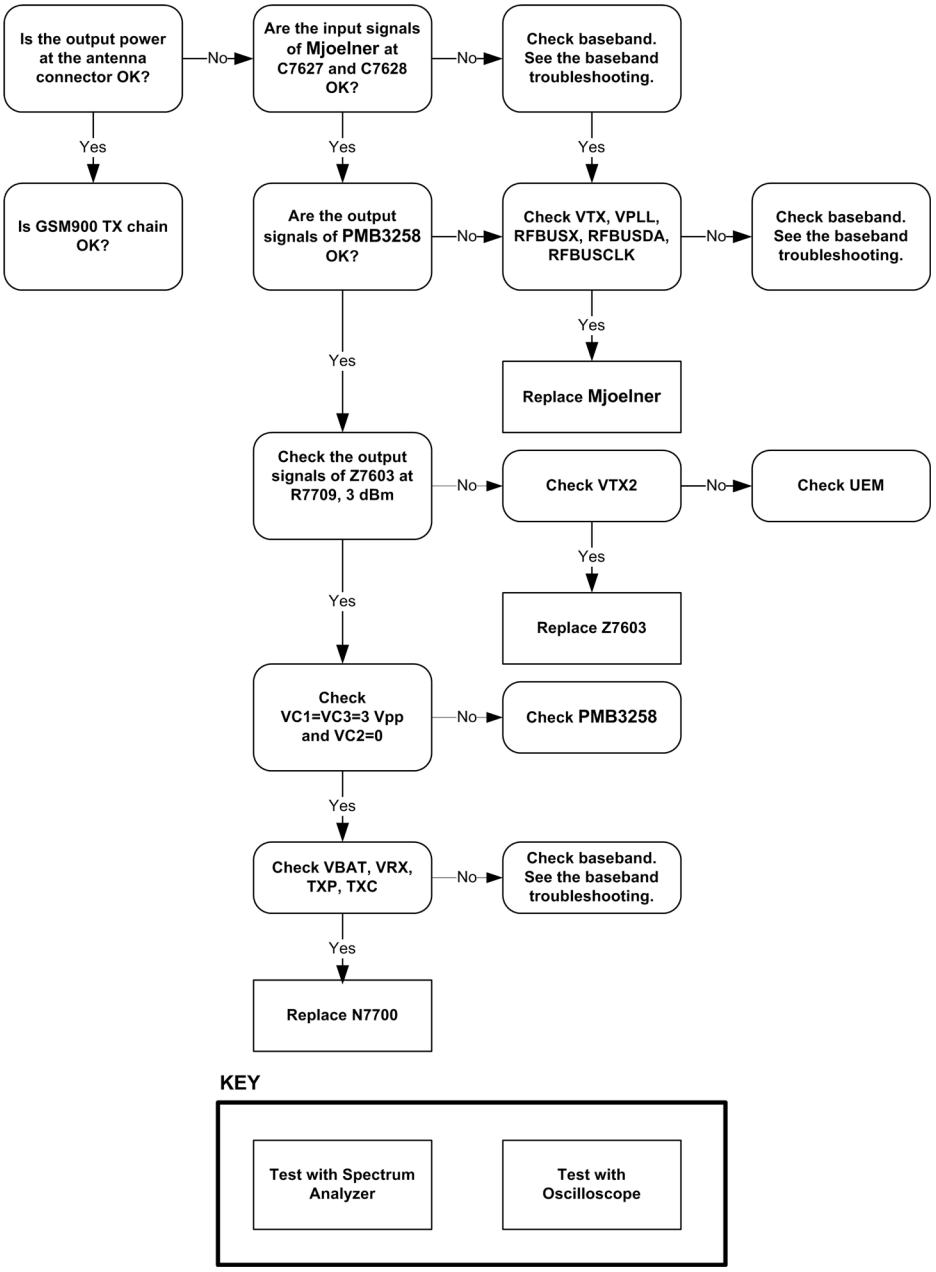



**Figure 43 GSM900 tarnsmitter troubleshooting**

## GSM900 TX output power

Measure the output power of the phone; it should be about 32.5dBm. Remember the cable loss is about 0.3dB.


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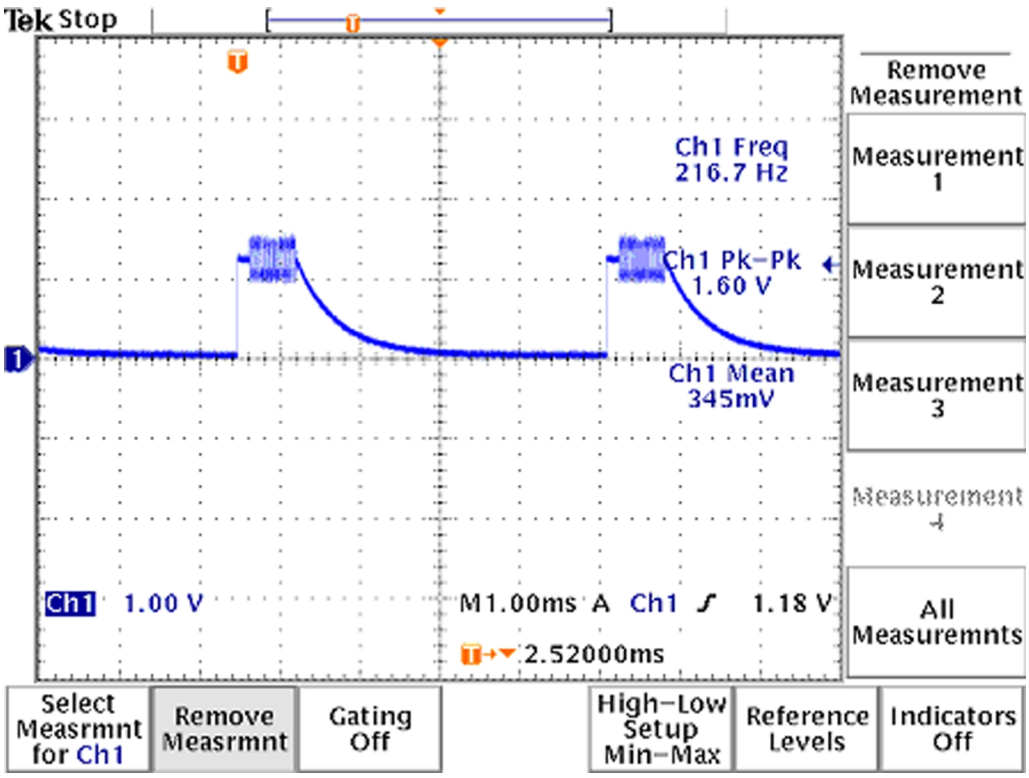



**Figure 44 TX I/O signal**

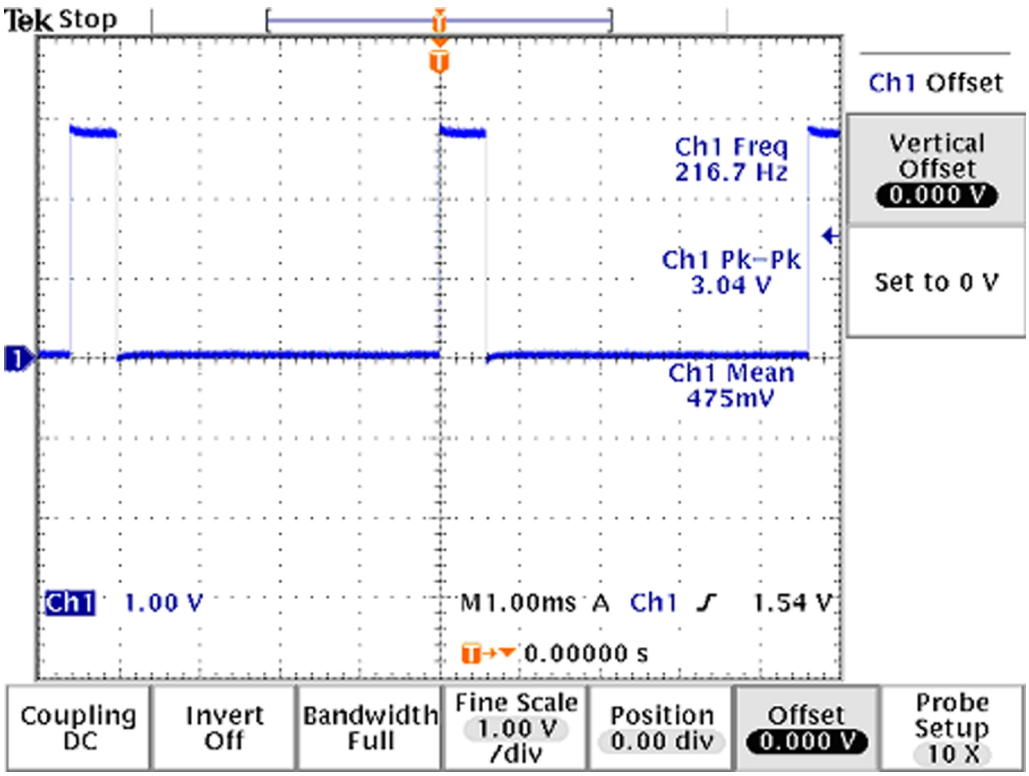



**Figure 45 VC1, VC3 signals**


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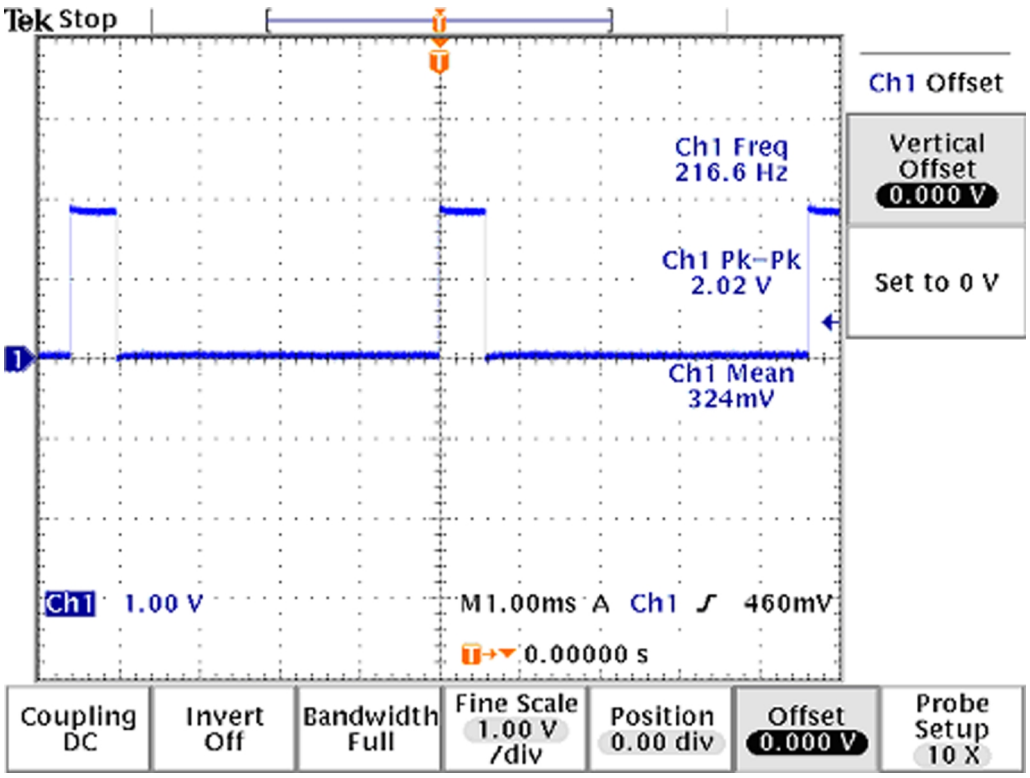



**Figure 46 TXP signal**

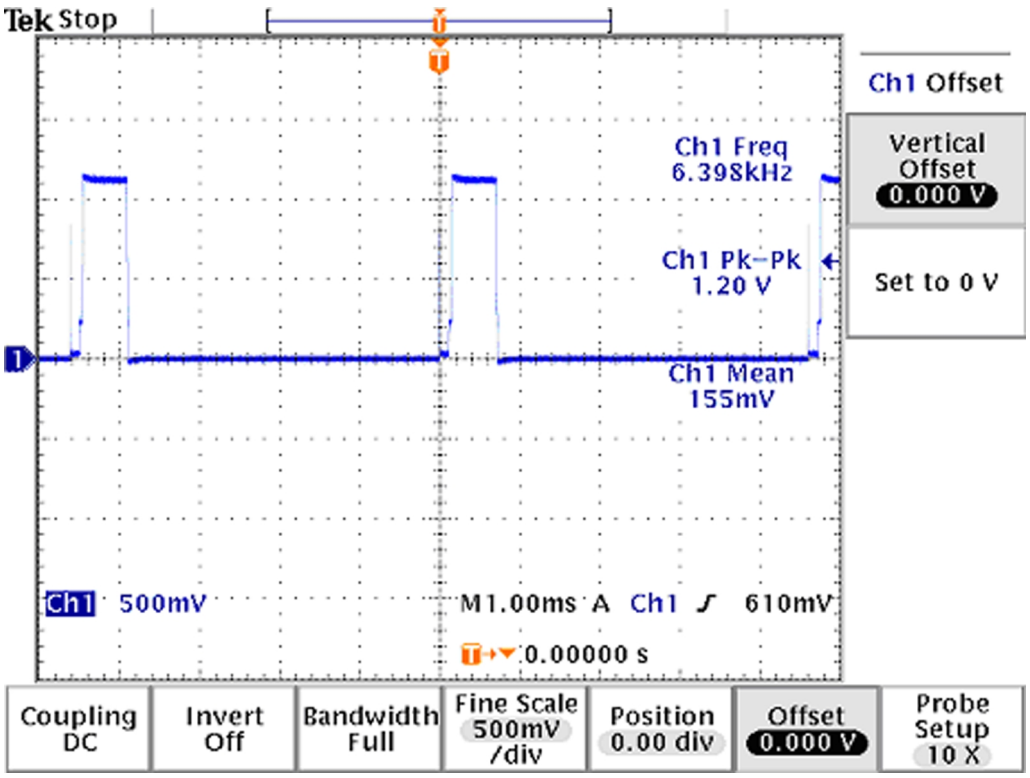



**Figure 47 TXC signals at PCL5**


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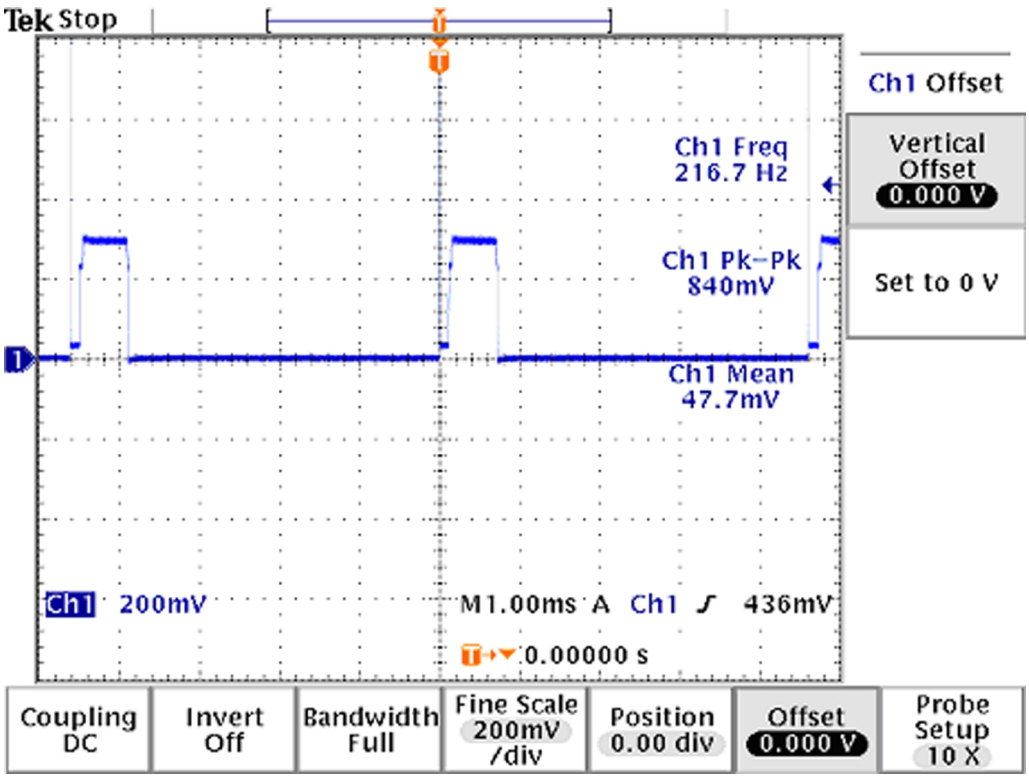



**Figure 48 TXC signals at PCL19**

## General instructions for GSM1800 TX troubleshooting

### Steps

1. Apply a RF-cable to the RF-connector to allow the transmitted signal act as normal. RF-cable should be connected to an attenuator at least 10dB before connected to the measurement equipment, otherwise the PA may be damaged.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   i Band: GSM 1800
   ii Active Unit: TX
   iii TX Power Level: 0
   iv TX Data Type: Random

### Results

The setup should now look like this:


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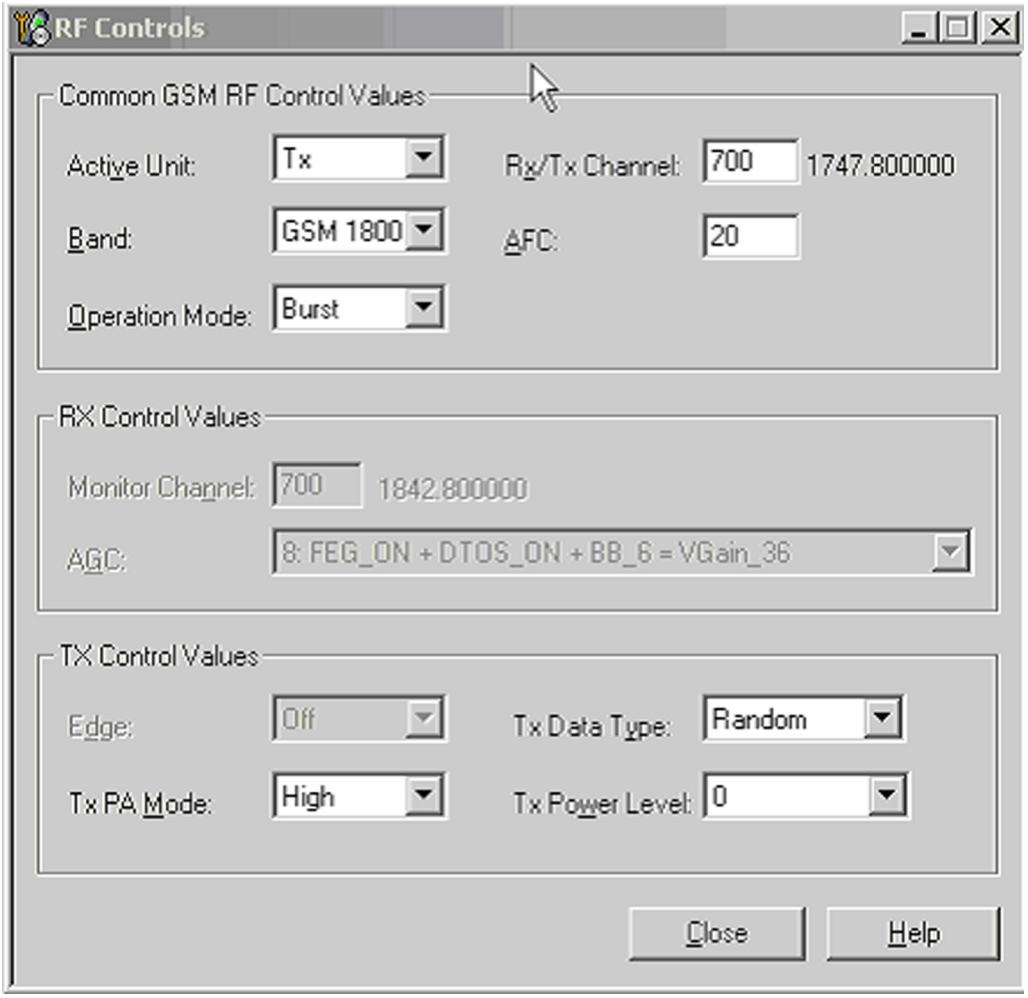



**Figure 49 GSM 1800 RF controls window**


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## Troubleshooting diagram for GSM1800 transmitter

### Troubleshooting flow

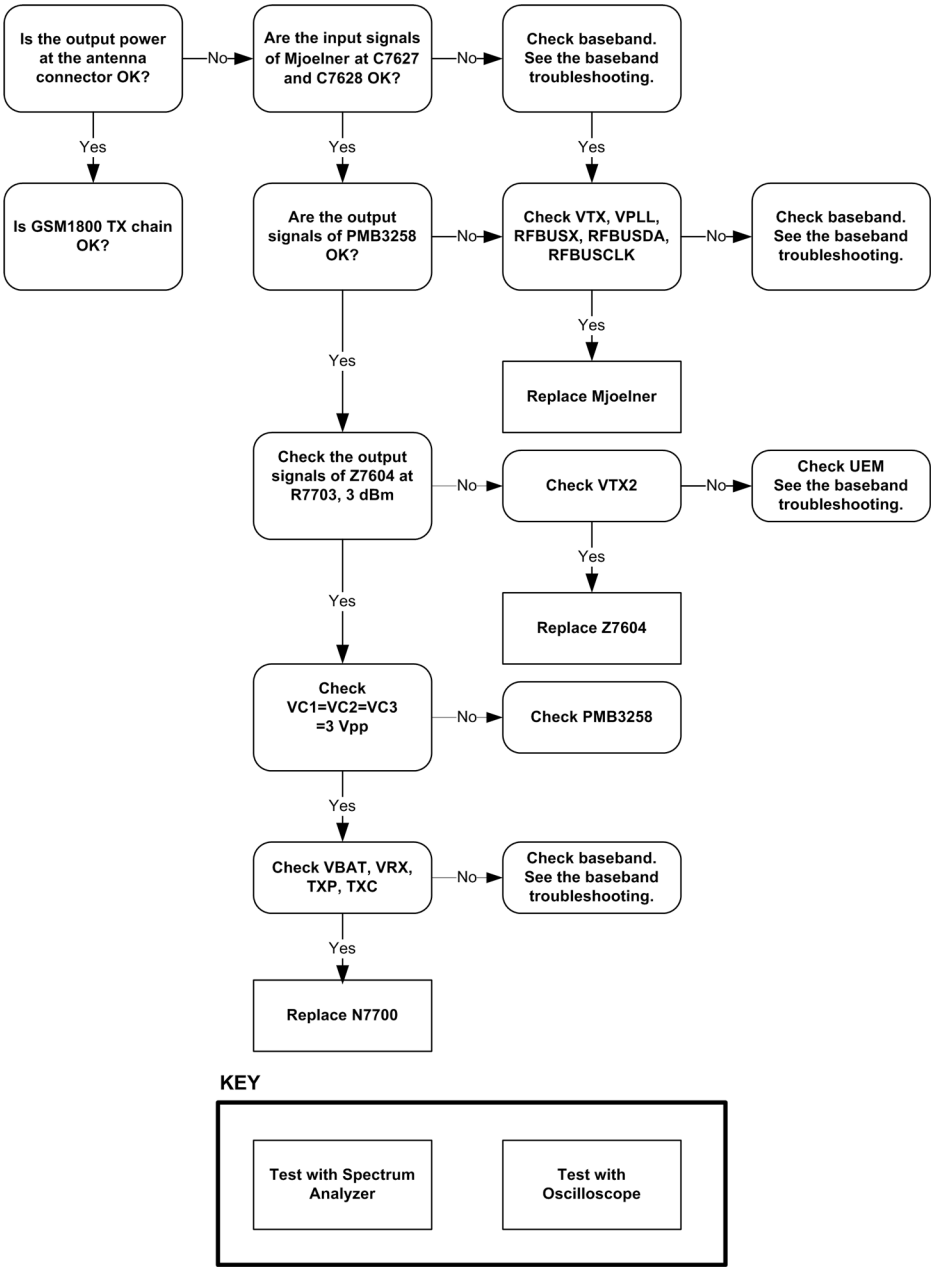



**Figure 50 GSM1800 transmitter troubleshooting**

## GSM1800 TX output power

Measure the output power of the phone; it should be about 30.5dBm. Remember the cable loss is about 0.5dB.


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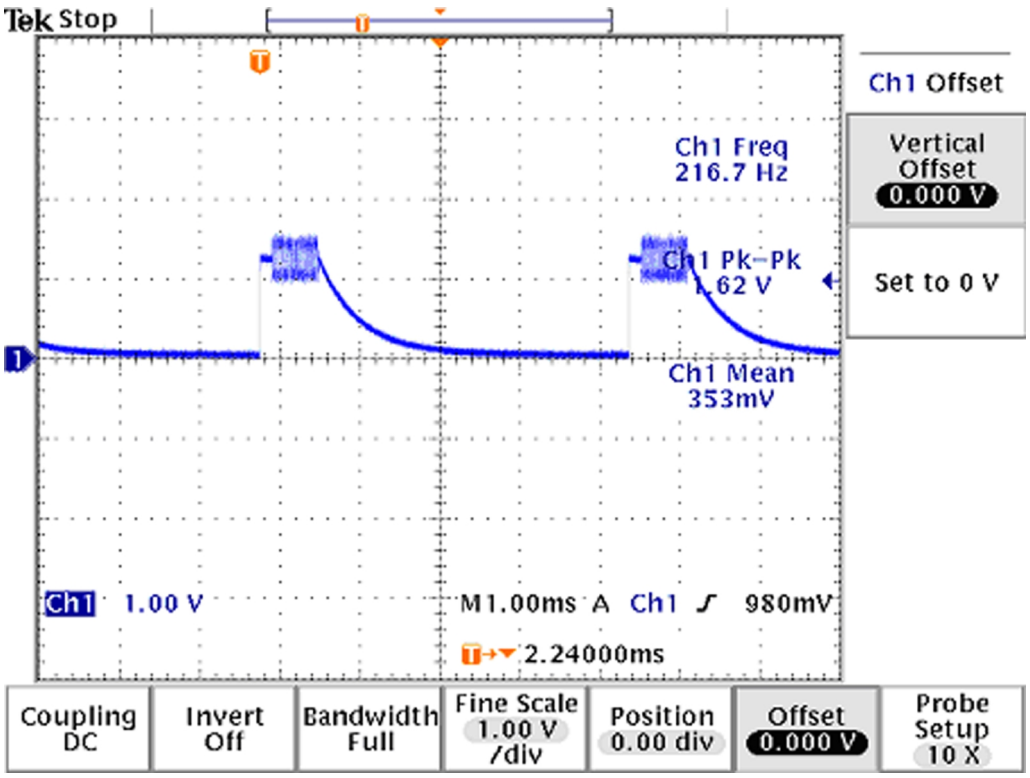



**Figure 51 TX I/O signal**

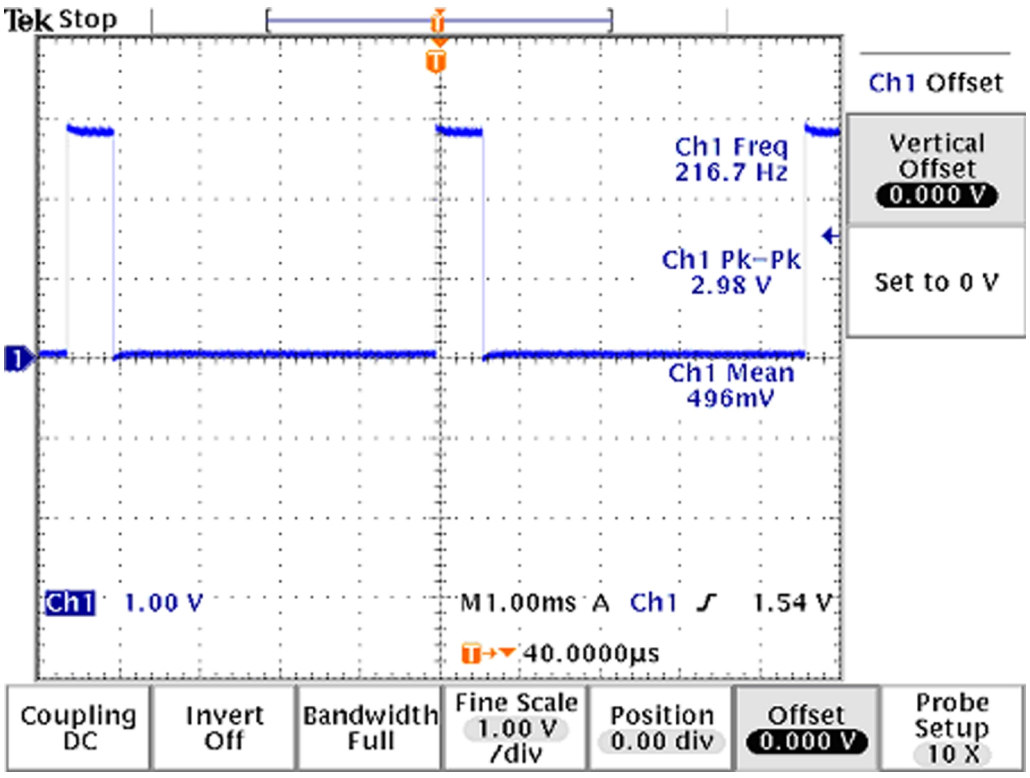



**Figure 52 VC1, VC2, VC3 signals**


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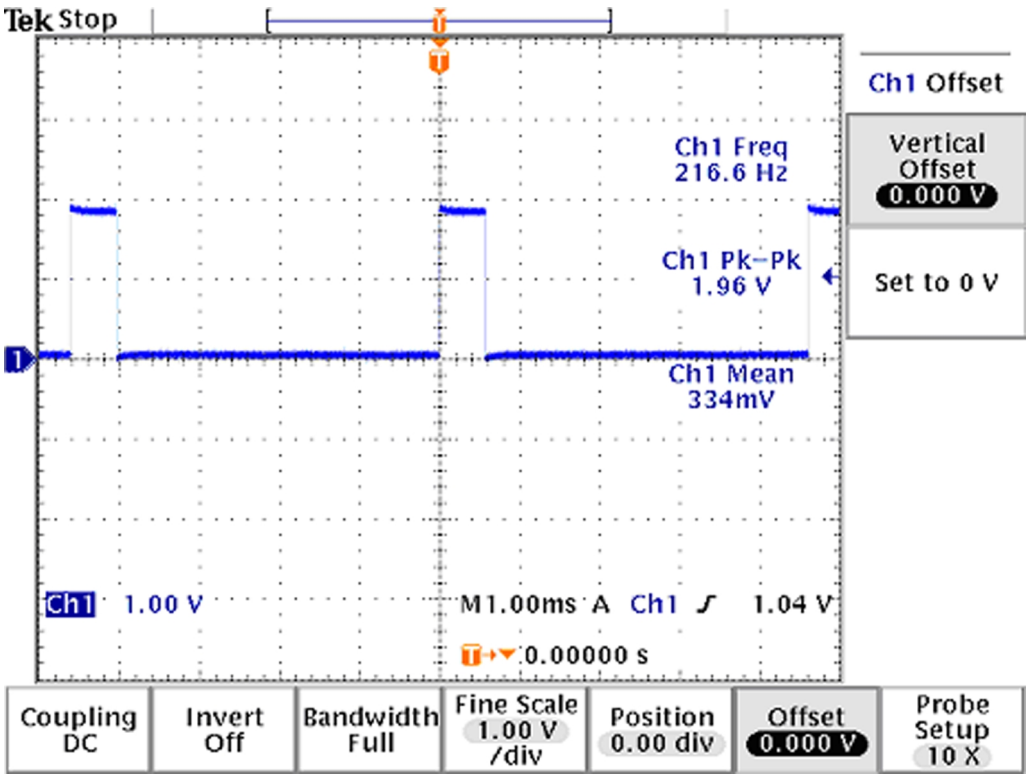



**Figure 53 TXP signal**

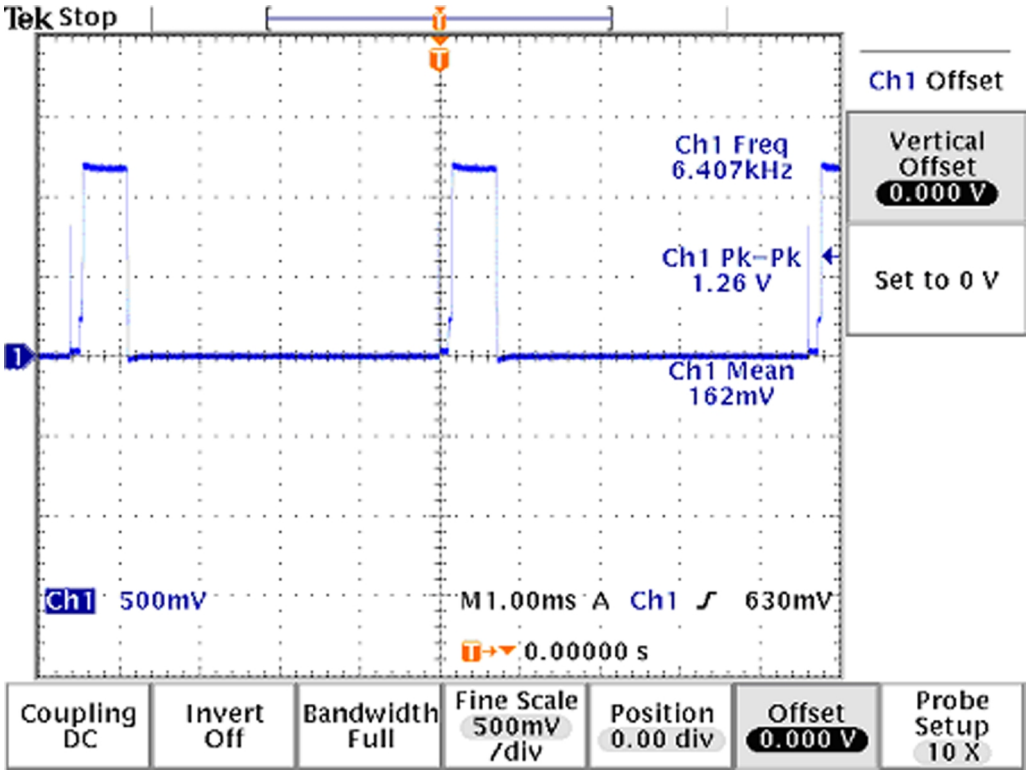



**Figure 54 TXC signals at PCL0**


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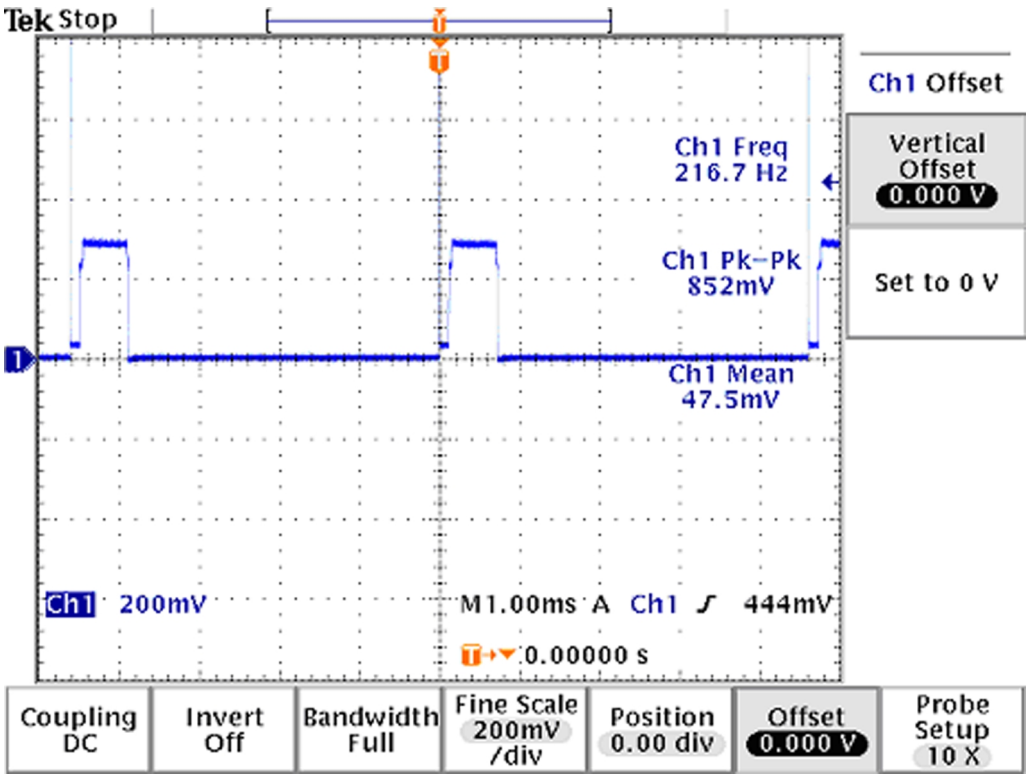



**Figure 55 TXC signals at PCL15**

## RM-299 receiver

### General instructions for GSM 850 RX troubleshooting

#### Steps

1. Connect the phone to a PC with the module repair jig.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   - i Active Unit: RX
   - ii Band: GSM 850
   - iii Operation Mode: Continuous mode
   - iv RX/TX Channel 190
   - v AGC: 8: FEG_ON + DTOS_ON+BB_6=Vgain_36

#### Results

The setup should now look like this:


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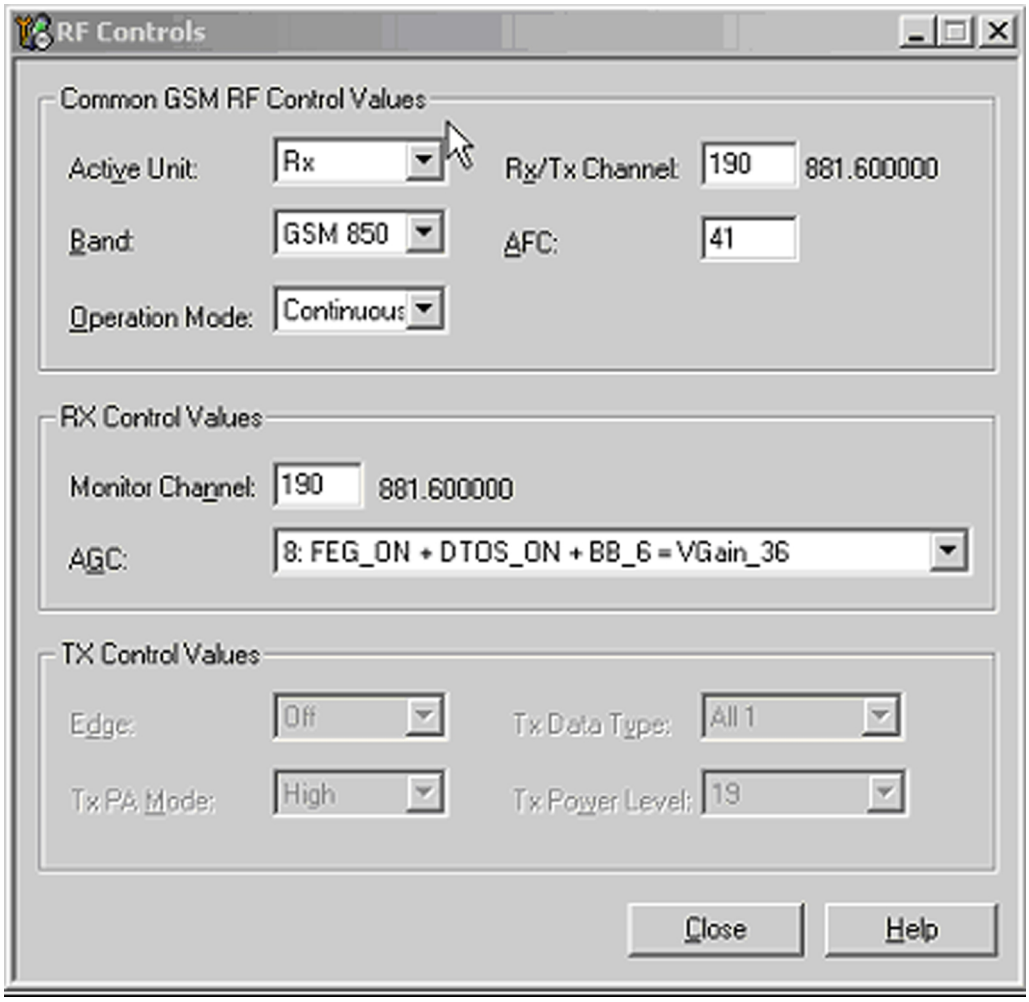



**Figure 56 GSM850 RF controls window**


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## Troubleshooting diagram for GSM850 receiver

### Troubleshooting flow

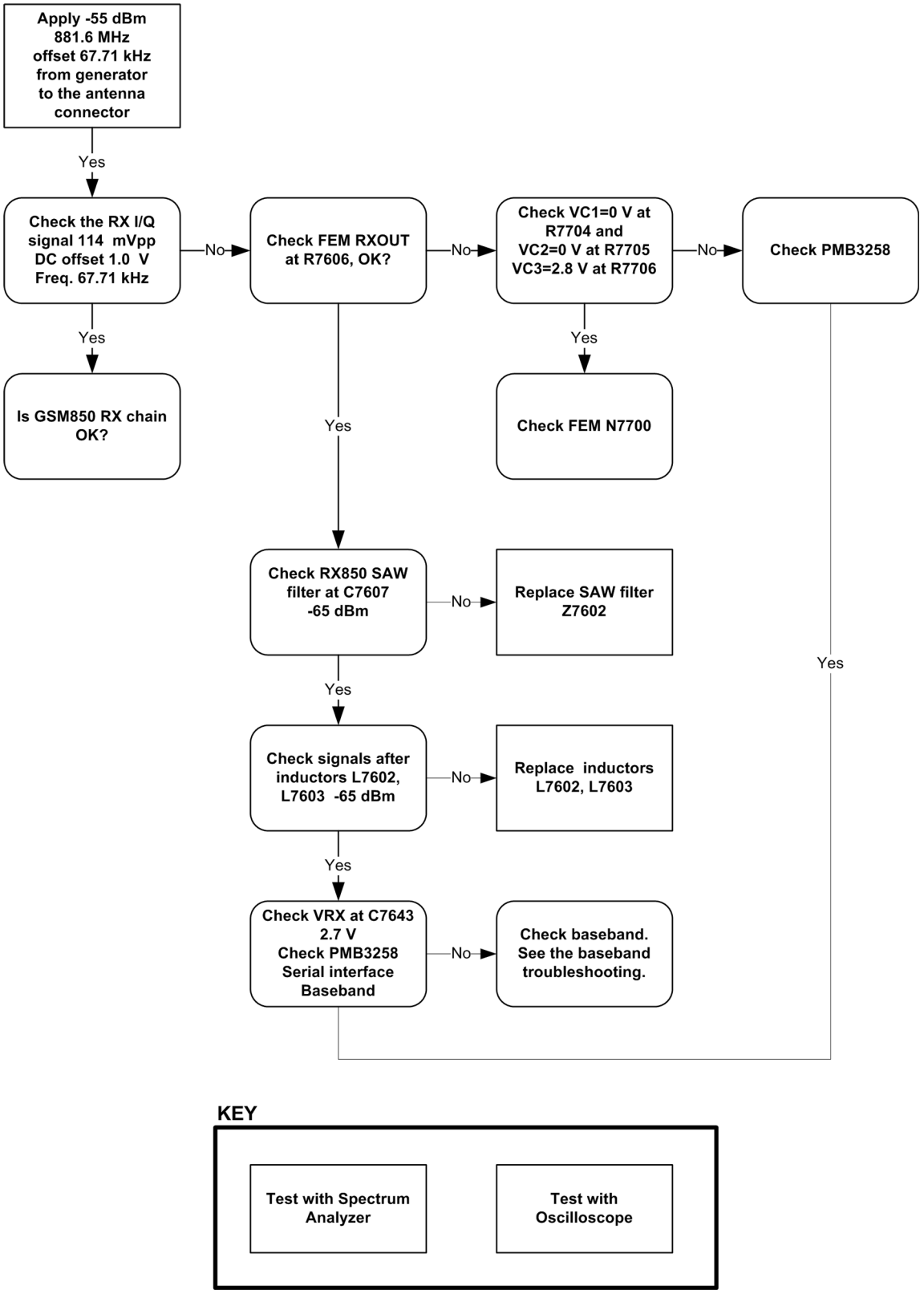



**Figure 57 GSM850 receiver troubleshooting**


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## Results

By measuring with an oscilloscope at RXIP or RXQP on a working GSM850 receiver this picture should be seen. Signal amplitude 114mVp-p. DC offset 1.0V.

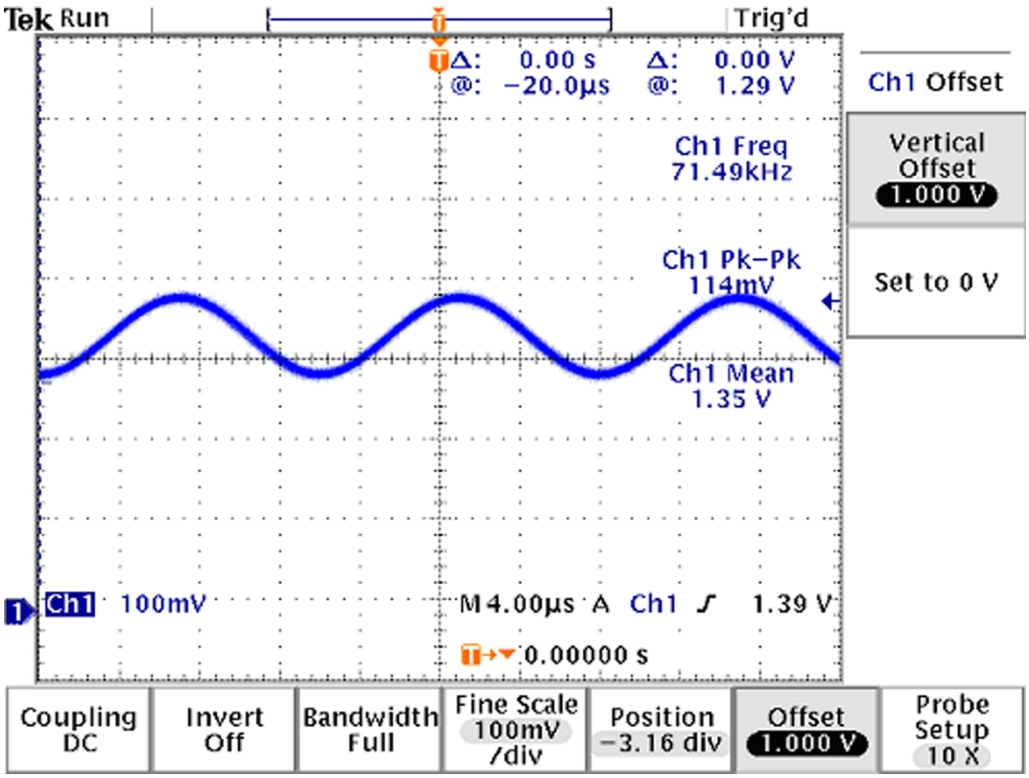



**Figure 58 850 RX I/Q signal waveform**

## General instructions for GSM1900 RX troubleshooting

## Steps

1. Connect the phone to a PC with the module repair jig.
2. Start Phoenix and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   - i Active Unit: RX
   - ii Band: GSM 1900
   - iii Operation Mode: Continuous mode
   - iv RX/TX Channel 661
   - v AGC: 8: FEG_ON + DTOS_ON+BB_6=Vgain_36

## Results

The setup should now look like this:


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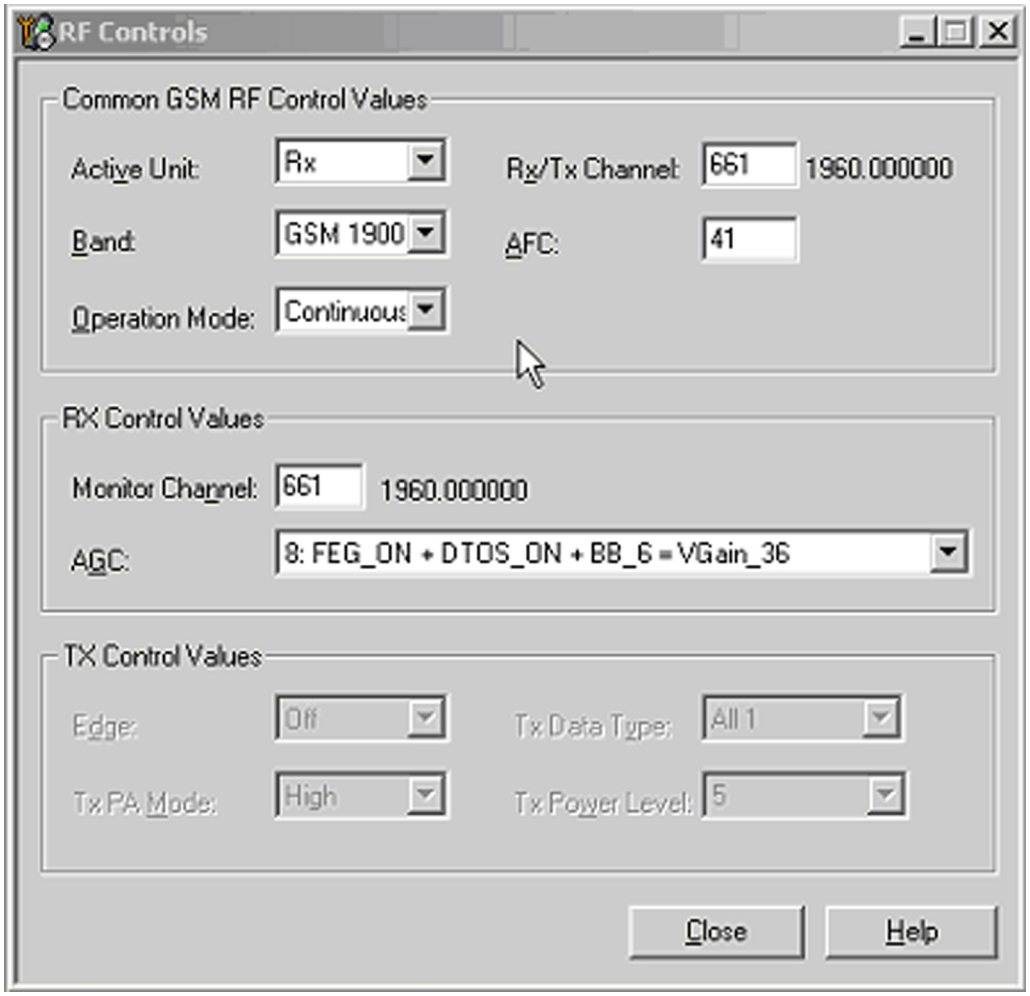



**Figure 59 GSM 1900 RF controls window**


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## Troubleshooting diagram for GSM1900 receiver

### Troubleshooting flow

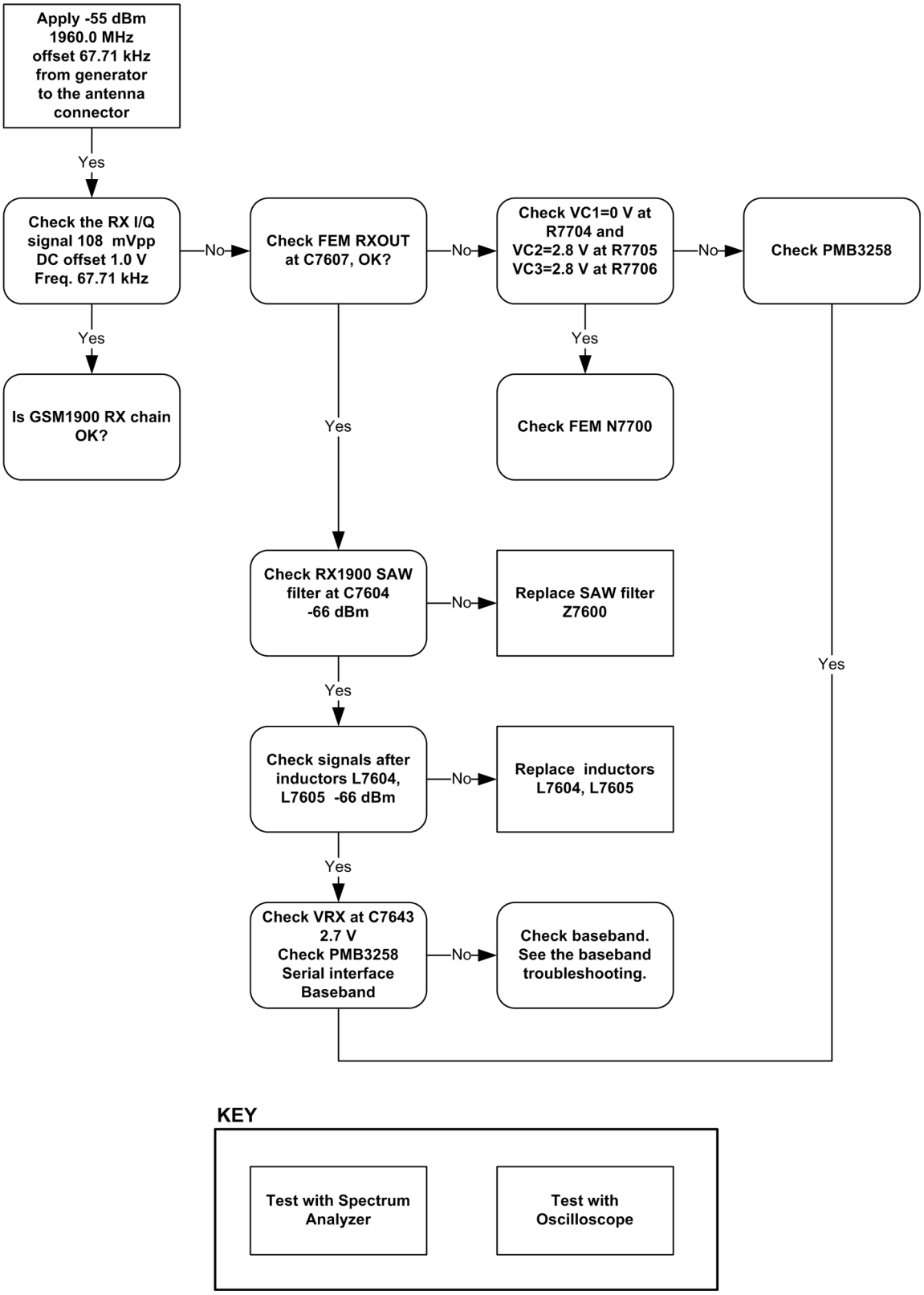



**Figure 60 GSM1900 receiver troubleshooting**


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## Results

By measuring with an oscilloscope at RXIP or RXQP on a working GSM1900 receiver this picture should be seen. Signal amplitude 108 mVp-p. DC offset 1.0V.

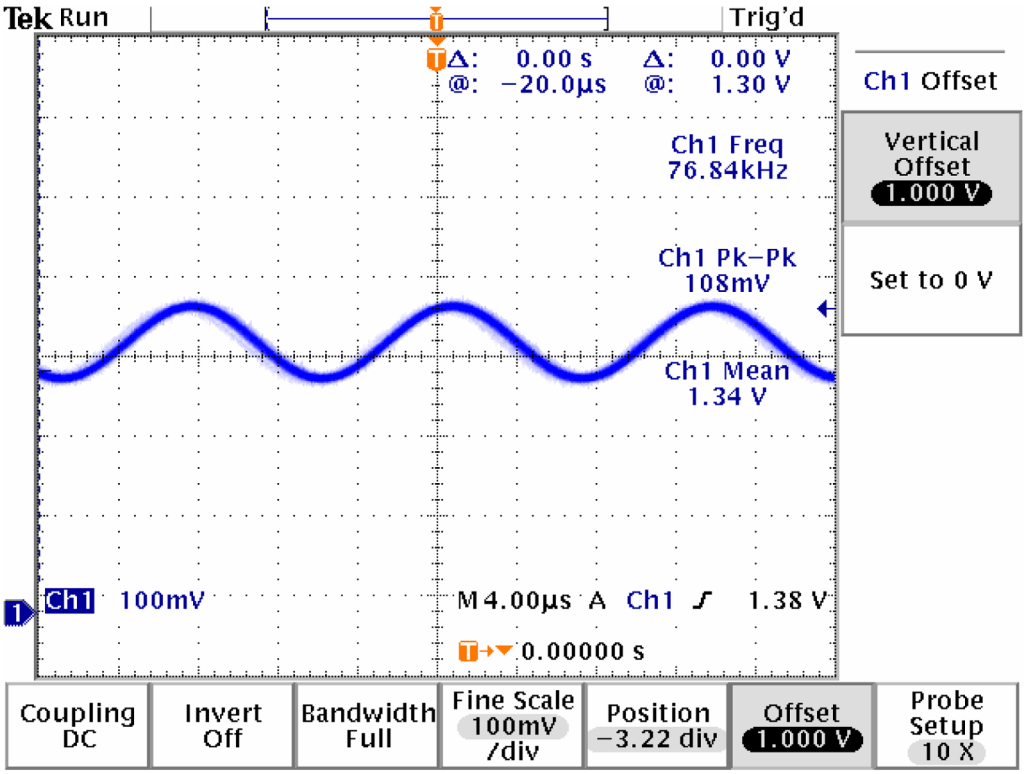



**Figure 61 1900 RX I/Q signal waveform**


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## Measurement points in the receiver

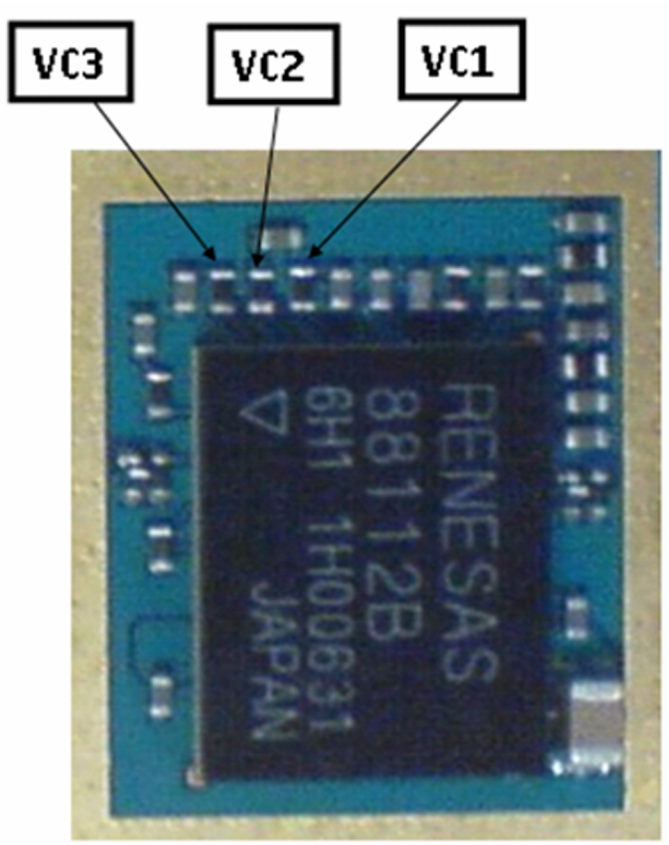



**Figure 62 RX measurements point of the control voltages to FEM N7700**

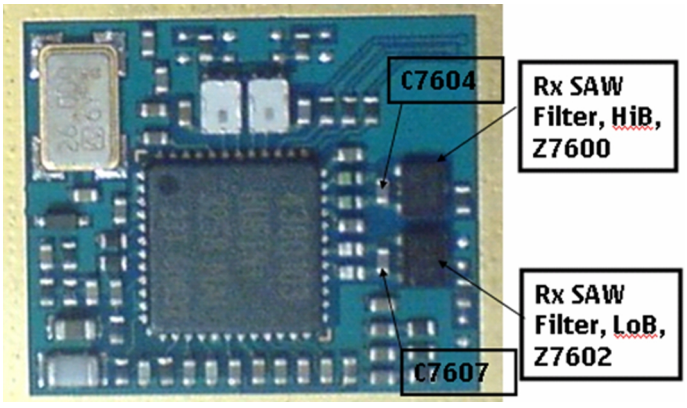



**Figure 63 Measurement points at the RX SAW Filters – Z7600/Z7602**


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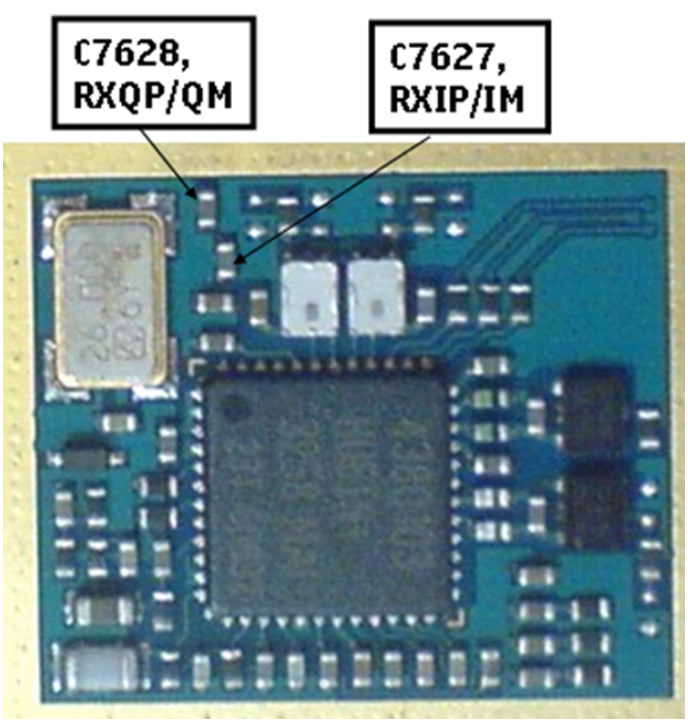



**Figure 64 RX I/Q signals**

## RM-299 transmitter

### General instructions for GSM 850 TX troubleshooting

#### Steps

1. Apply a RF-cable to the RF-connector to allow the transmitted signal act as normal. RF-cable should be connected to an attenuator at least 10dB before connected to the measurement equipment, otherwise the PA may be damaged.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   i Band: GSM 850
   ii Active Unit: TX
   iii TX Power Level: 5
   iv TX Data Type: Random

#### Results

The setup should now look like this:


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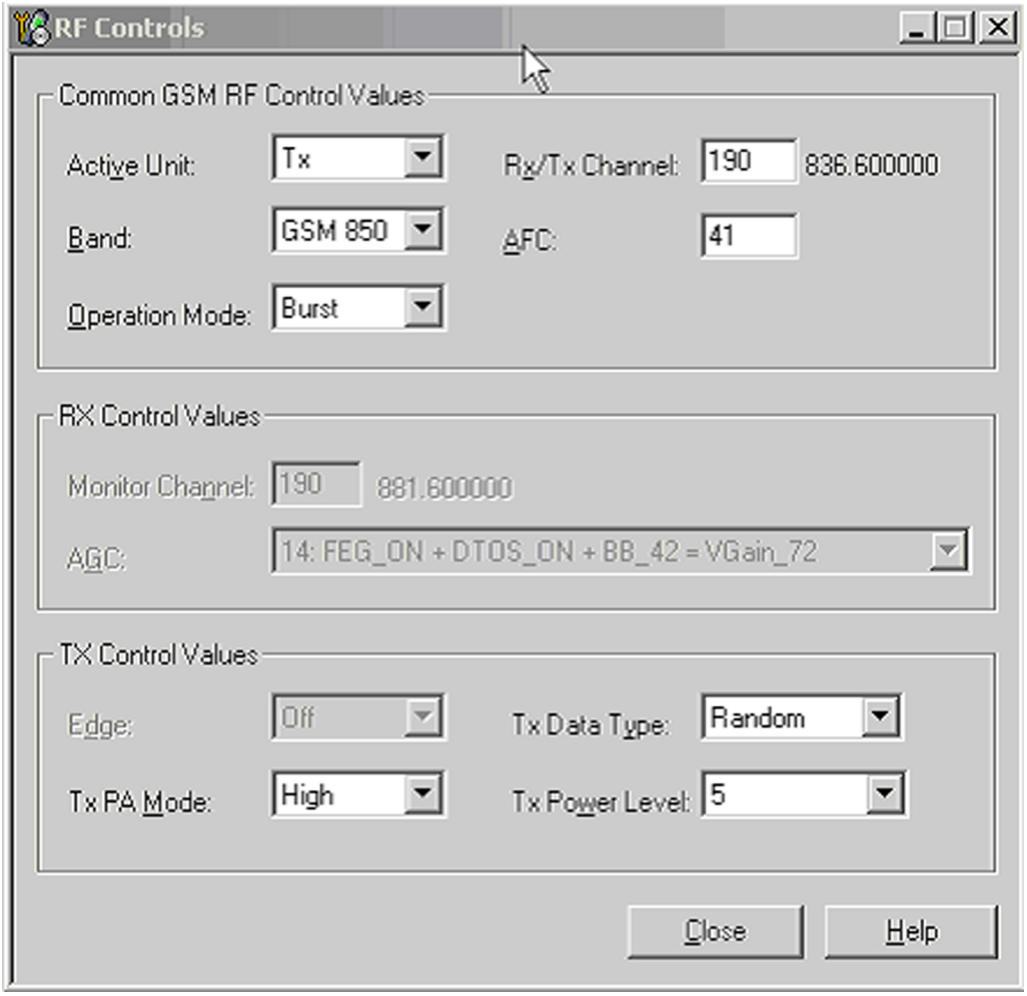



**Figure 65 GSM 850 RF controls window**


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## Troubleshooting diagram for GSM850 transmitter

### Troubleshooting flow

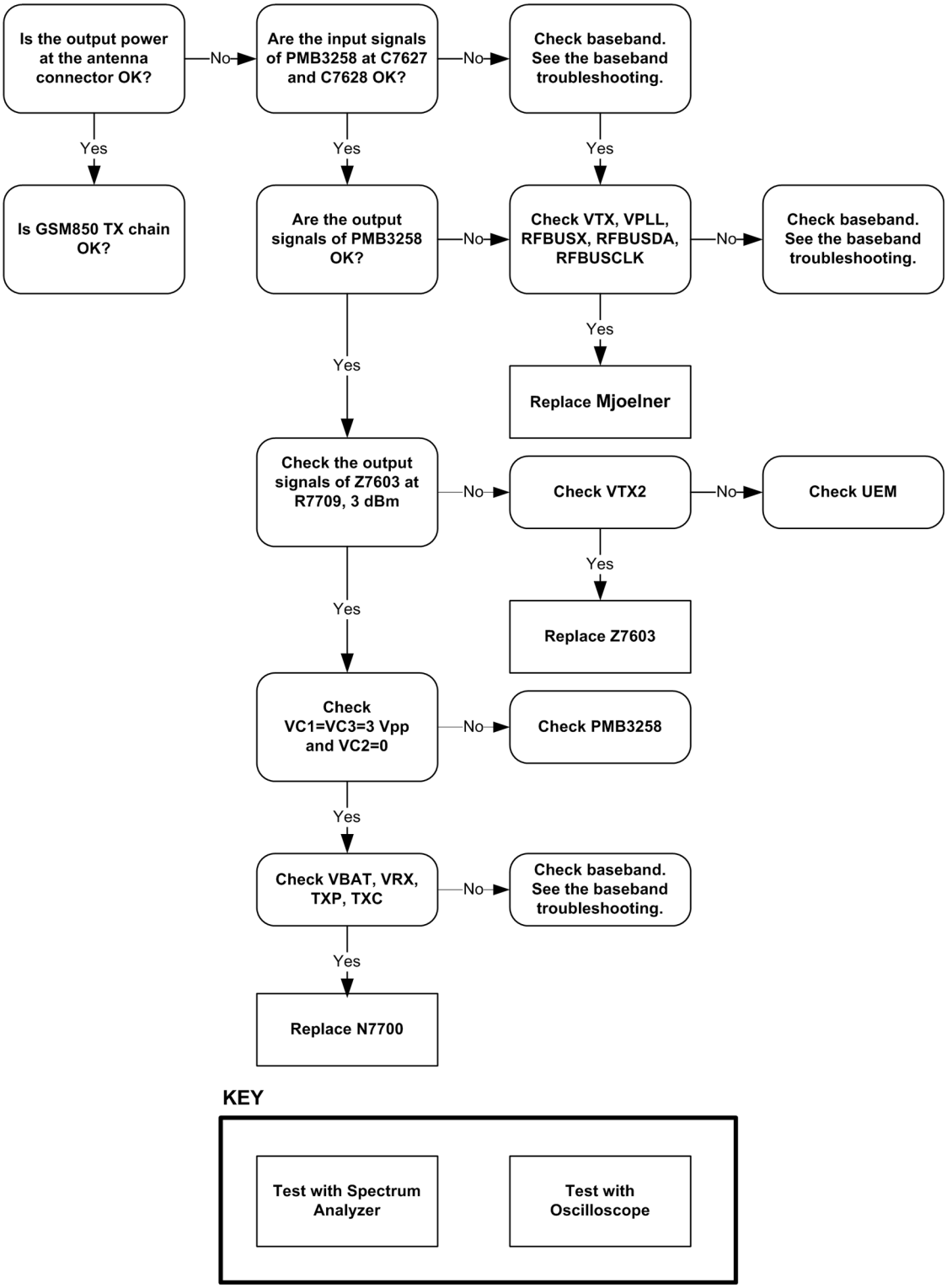



**Figure 66 GSM850 transmitter troubleshooting**


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## GSM850 TX output power

Measure the output power of the phone; it should be about 32.5 dBm. Remember the cable loss is about 0.3 dB.

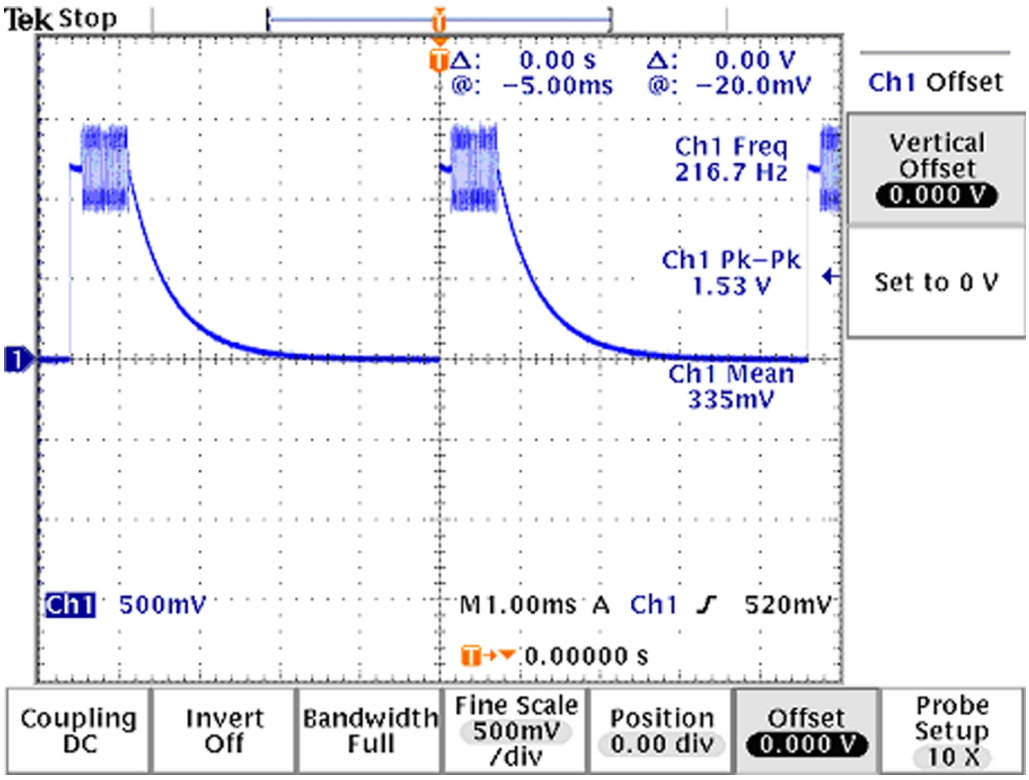



**Figure 67 TX I/O signal**

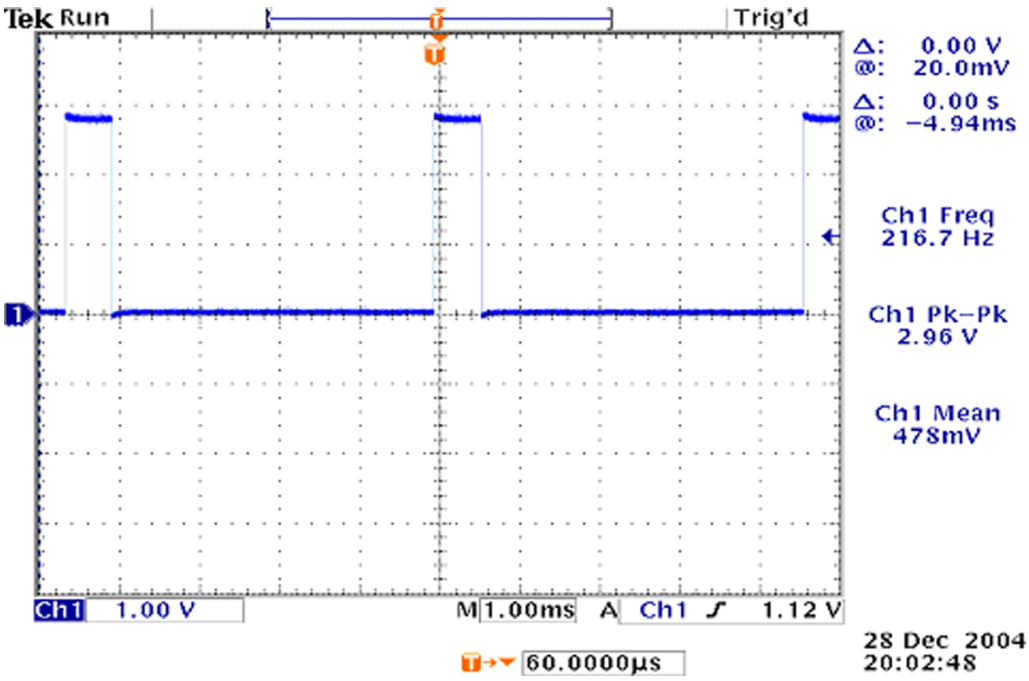



**Figure 68 VC1, VC3 signal**


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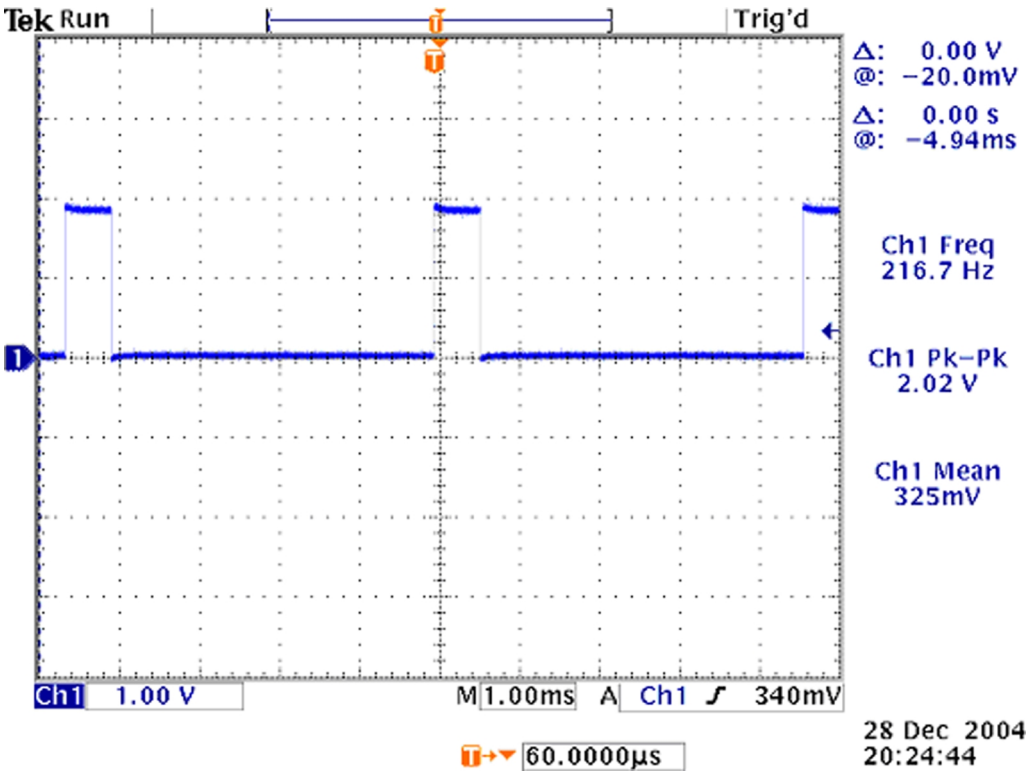



**Figure 69 TXP signal**

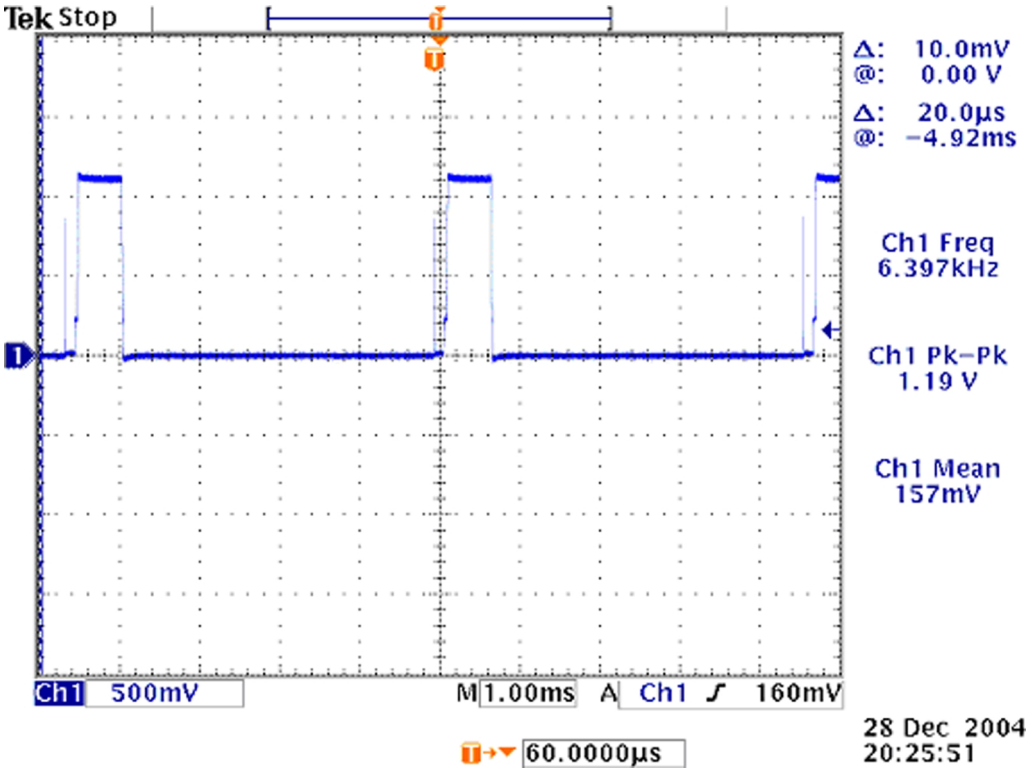



**Figure 70 TXC signals at PCL5**


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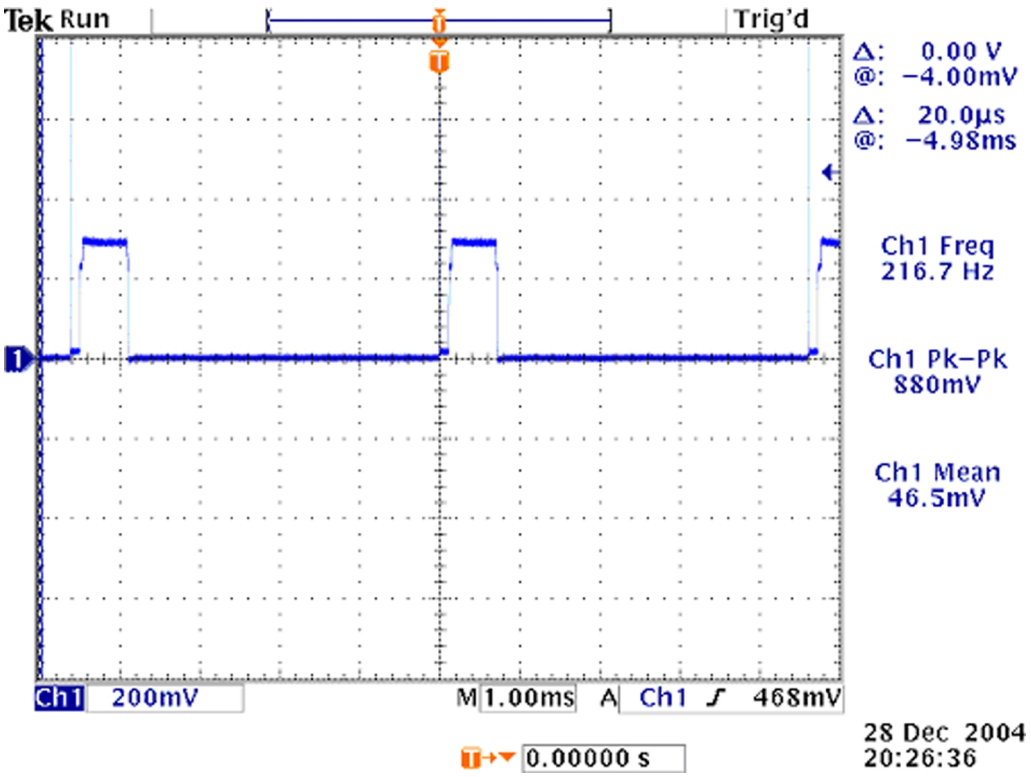



**Figure 71 TXC signals at PCL19**

## General instructions for GSM1900 TX troubleshooting

### Steps

1. Apply a RF-cable to the RF-connector to allow the transmitted signal act as normal. RF-cable should be connected to an attenuator at least 10dB before connected to the measurement equipment, otherwise the PA may be damaged.
2. Start *Phoenix* and establish a connection to the phone with the data cable e.g. FBUS.
3. Select File and Scan product.
4. Wait a while for the PC to read the information from the phone.
5. Select Testing and RF Controls.
6. Set the parameters as follows:
   i Band: GSM 1900
   ii Active Unit: TX
   iii TX Power Level: 0
   iv TX Data Type: Random


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7. The setup should now look like this:

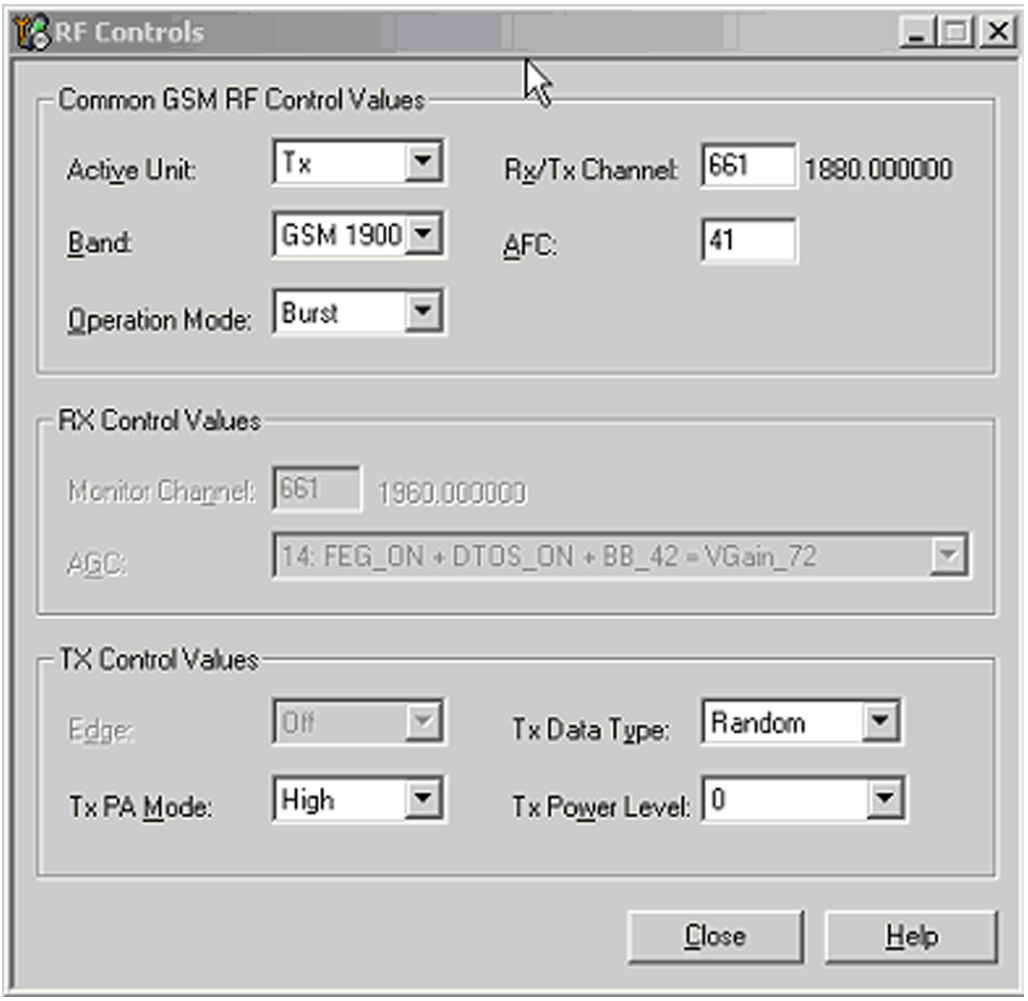



**Figure 72 GSM 1900 RF controls window**


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## Troubleshooting diagram for GSM1900 transmitter

### Troubleshooting flow

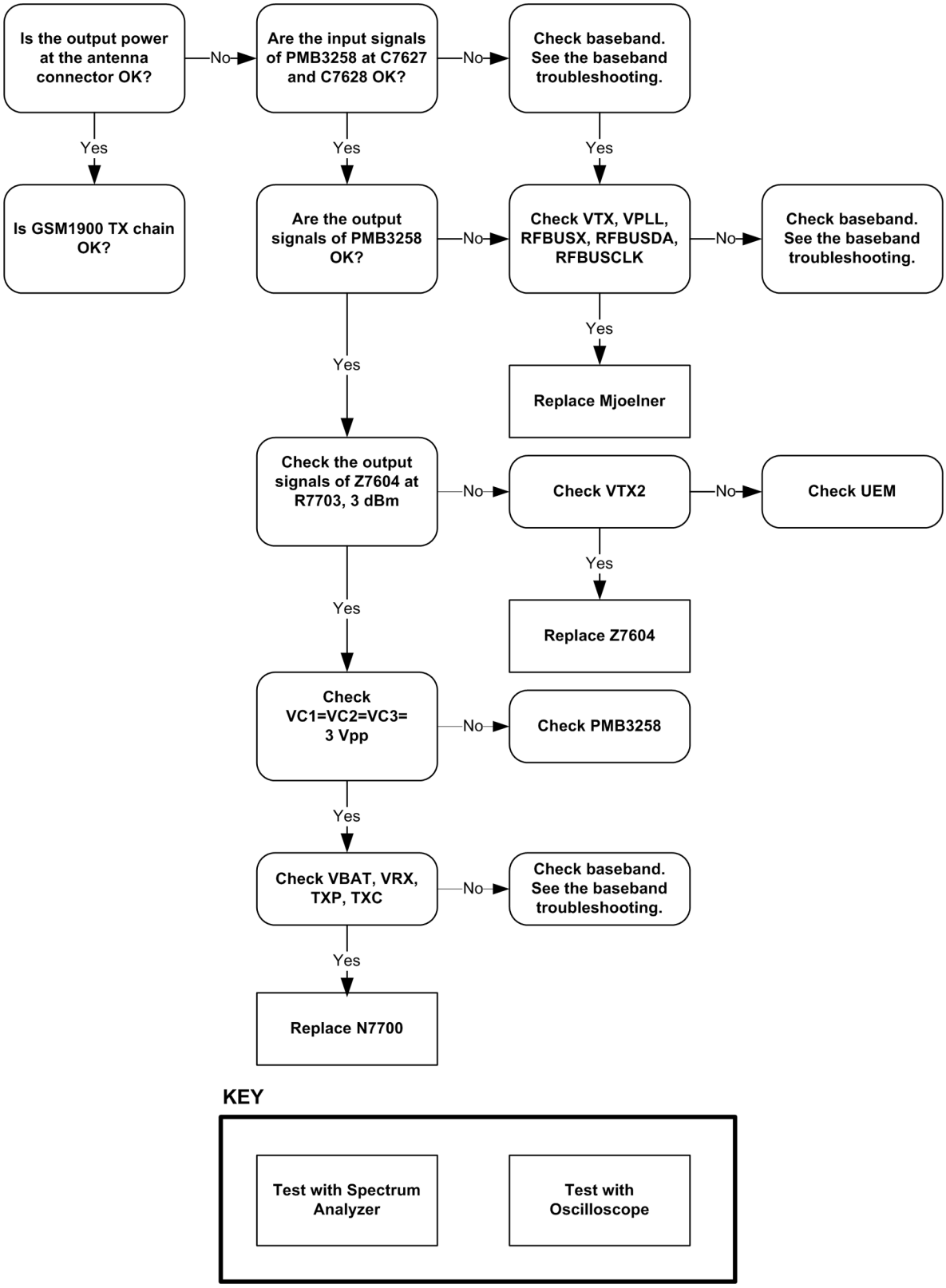



**Figure 73 GSM1900 transmitter troubleshooting**


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## GSM1900 TX output power

Measure the output power of the phone; it should be about 29.1dBm. Remember the cable loss is about 0.5dB.

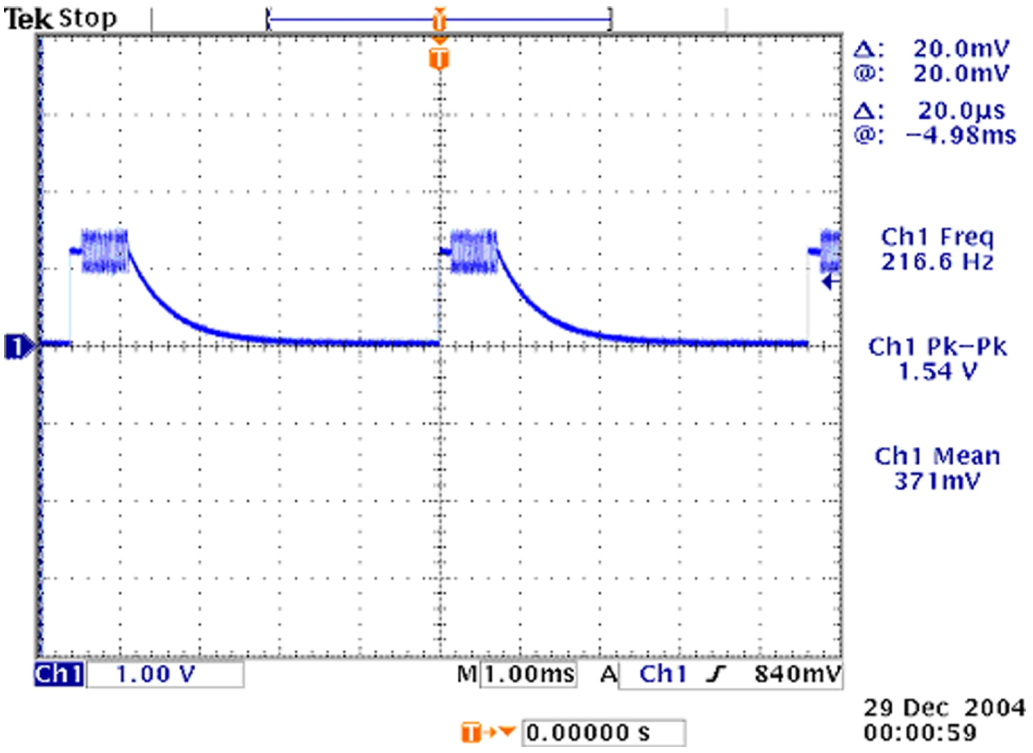



**Figure 74 TX I/O signal**

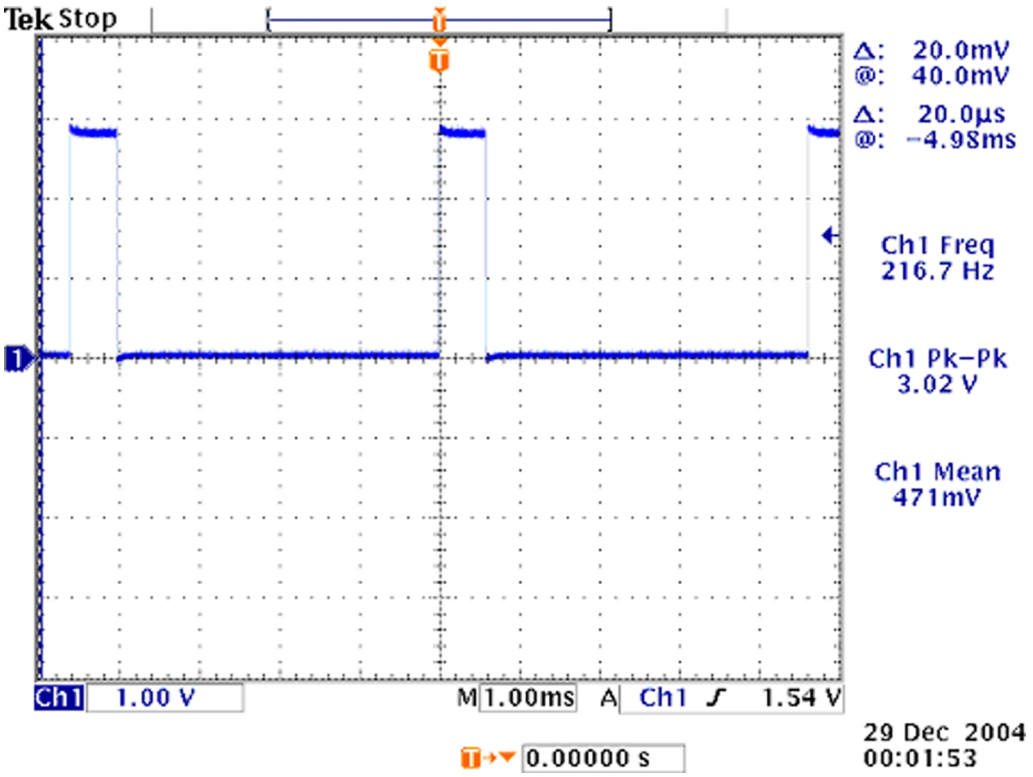



**Figure 75 VC1, VC2, VC3 signals**


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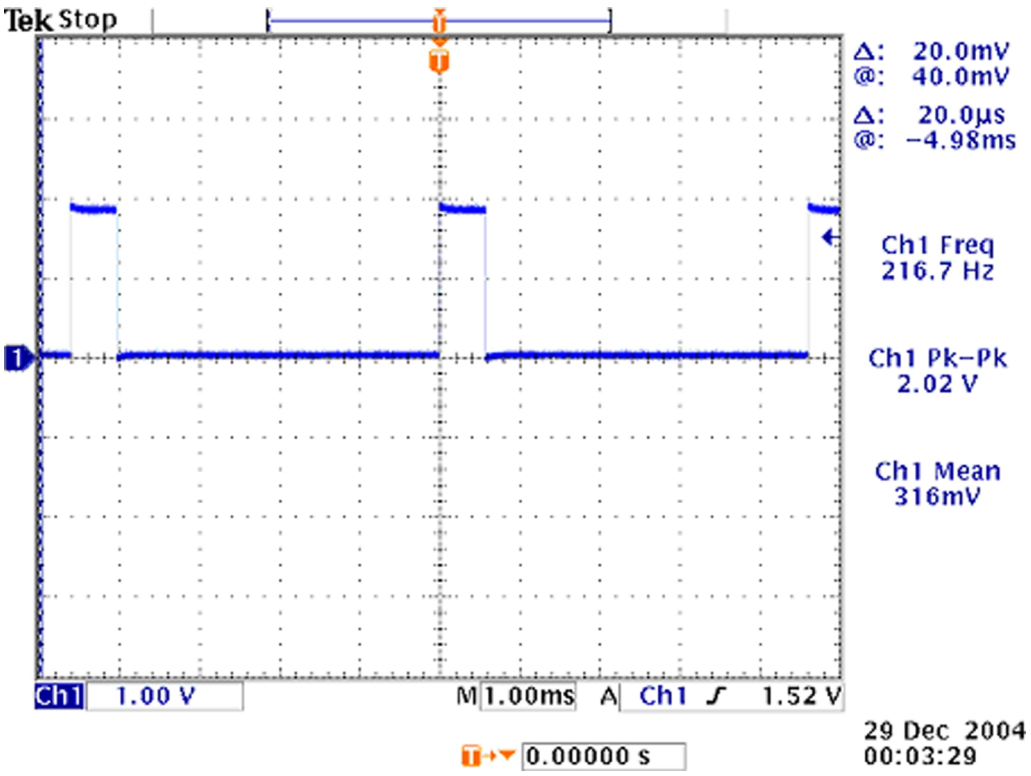



**Figure 76 TXP signal**

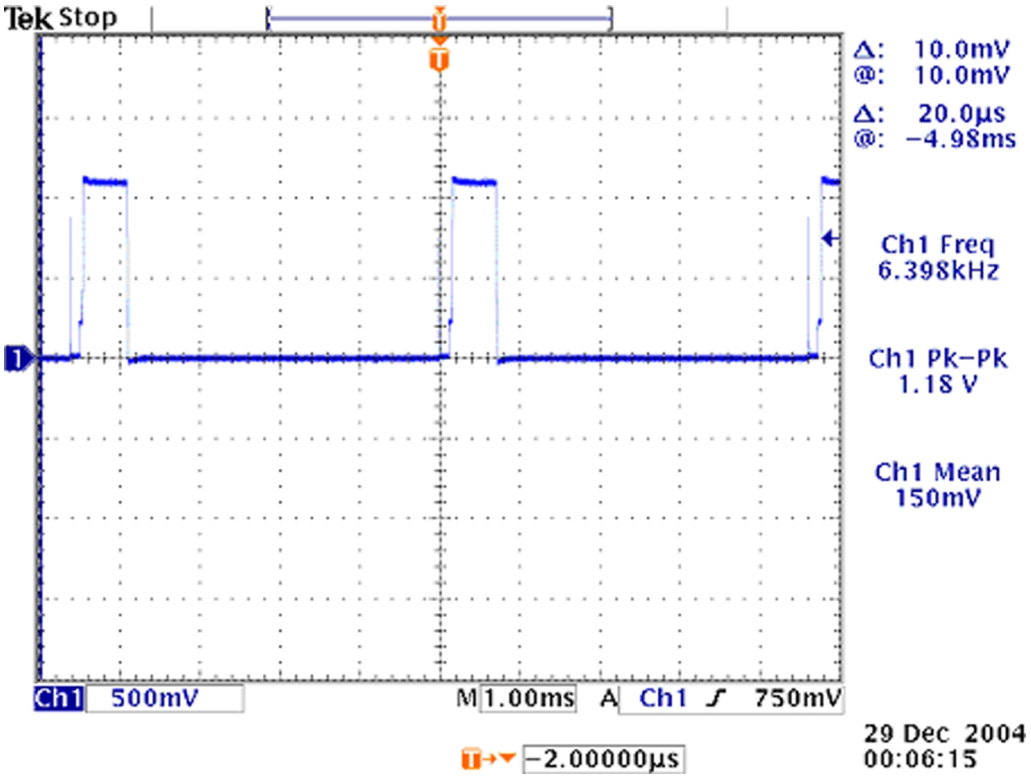



**Figure 77 TXC signals at PCL0**


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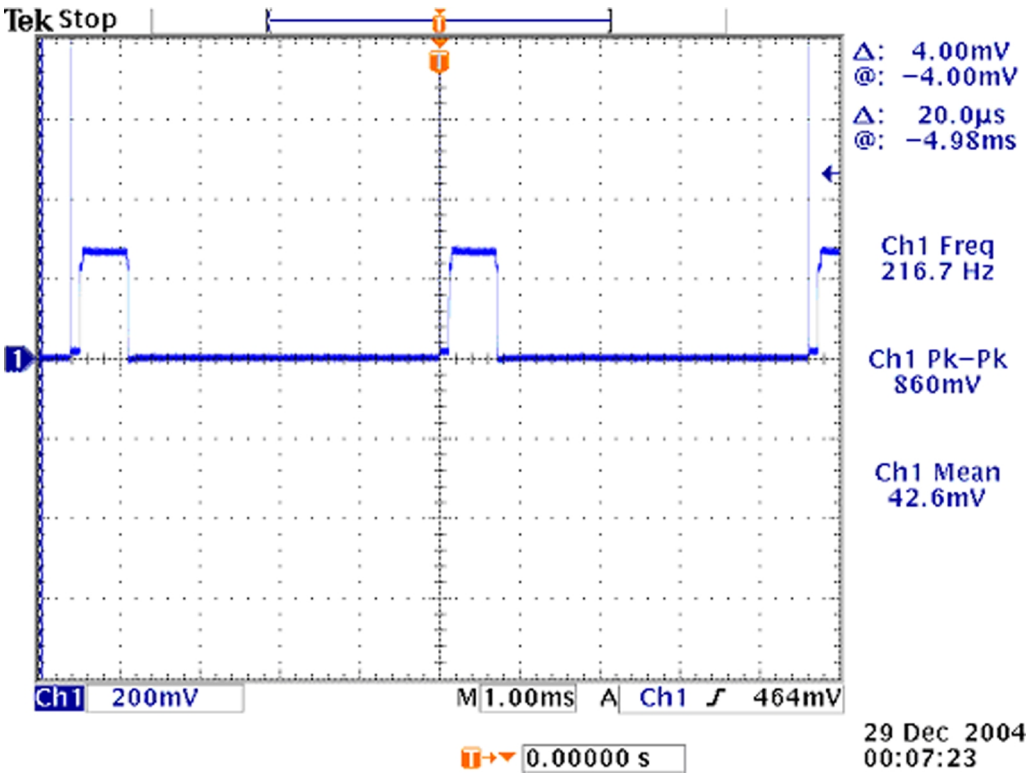



**Figure 78 TXC signals at PCL15**

## Synthesizer troubleshooting

### Introduction

### 26 MHz Reference Oscillator (VCXO)

There is only one PLL synthesizer generating Local Oscillator frequencies for both RX and TX in both bands (PCN and EGSM). The VCO frequency is divided by 2 for PCN operation or by 4 for EGSM operation inside the Mjoelner IC.

The 26MHz oscillator is located near the Mjoelner IC. (N7600). The coarse frequency for this oscillator is set by an external crystal (B7600). The reference oscillator is used as a reference frequency for the PLL synthesizer and as the system clock for the Baseband. The 26MHz signal is divided by 2 to achieve 13MHz inside the UPP IC (D2800).

The 26MHz signal from the VCXO can be measured by probing R2900. The level at this point is approx. 770mVpp. Frequency of this oscillator is adjusted by changing the AFC-register inside the UEM IC. Example Signal Measured at VCXO output (R2900).


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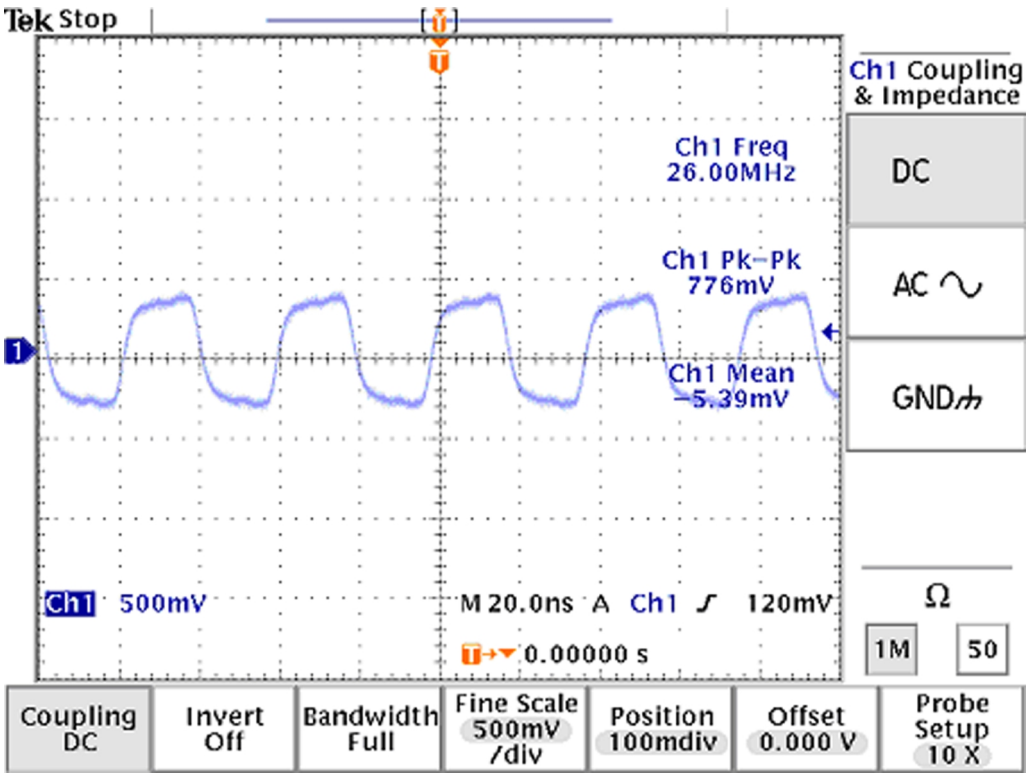



**Figure 79 VCXO 26 MHz waveform**


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## Troubleshooting diagram for PLL synthesizer

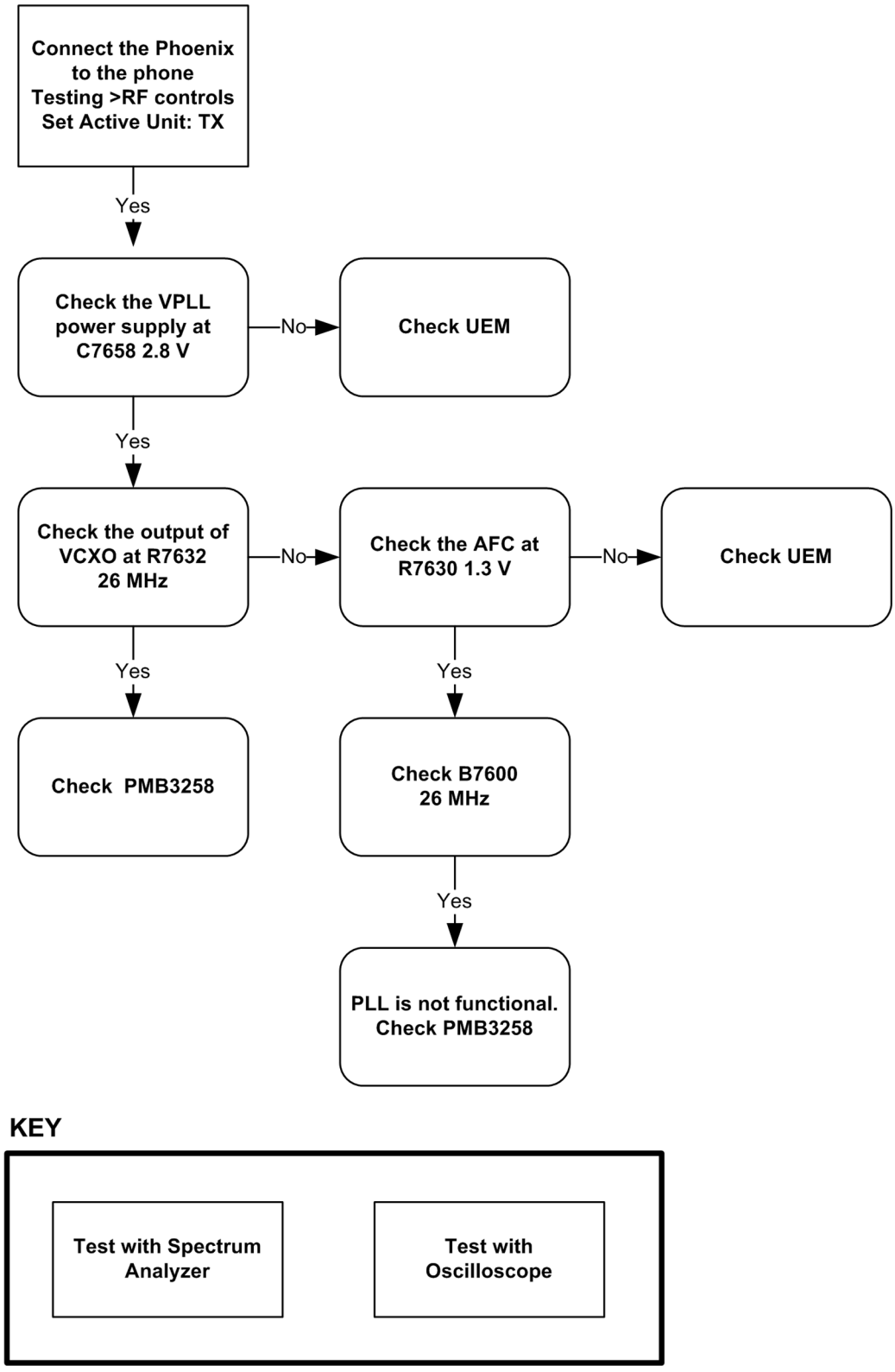



**Figure 80 PLL Troubleshooting diagram**


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### Measurement points at the VCXO

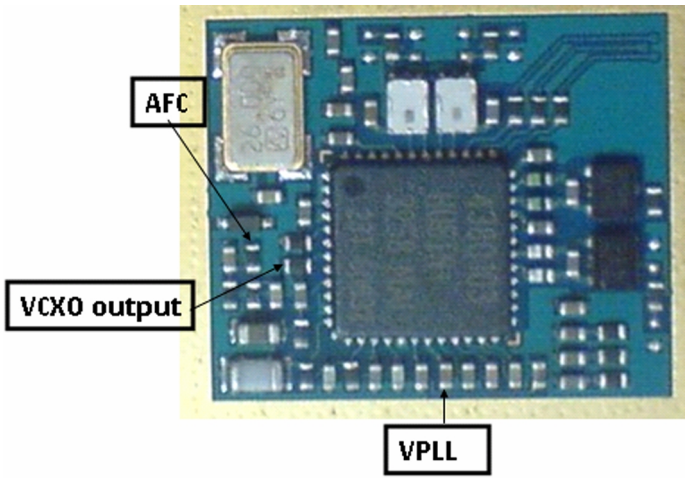



**Figure 81 Measurement point for VCXO**

## FM radio and bluetooth troubleshooting

### Measurement settings

#### Steps

1. Connect the phone to a PC with the module repair jig.
2. Start Phoenix and establish a connection to the phone with the data cable e.g. FBUS.
3. Phoenix settings shall be as follows:


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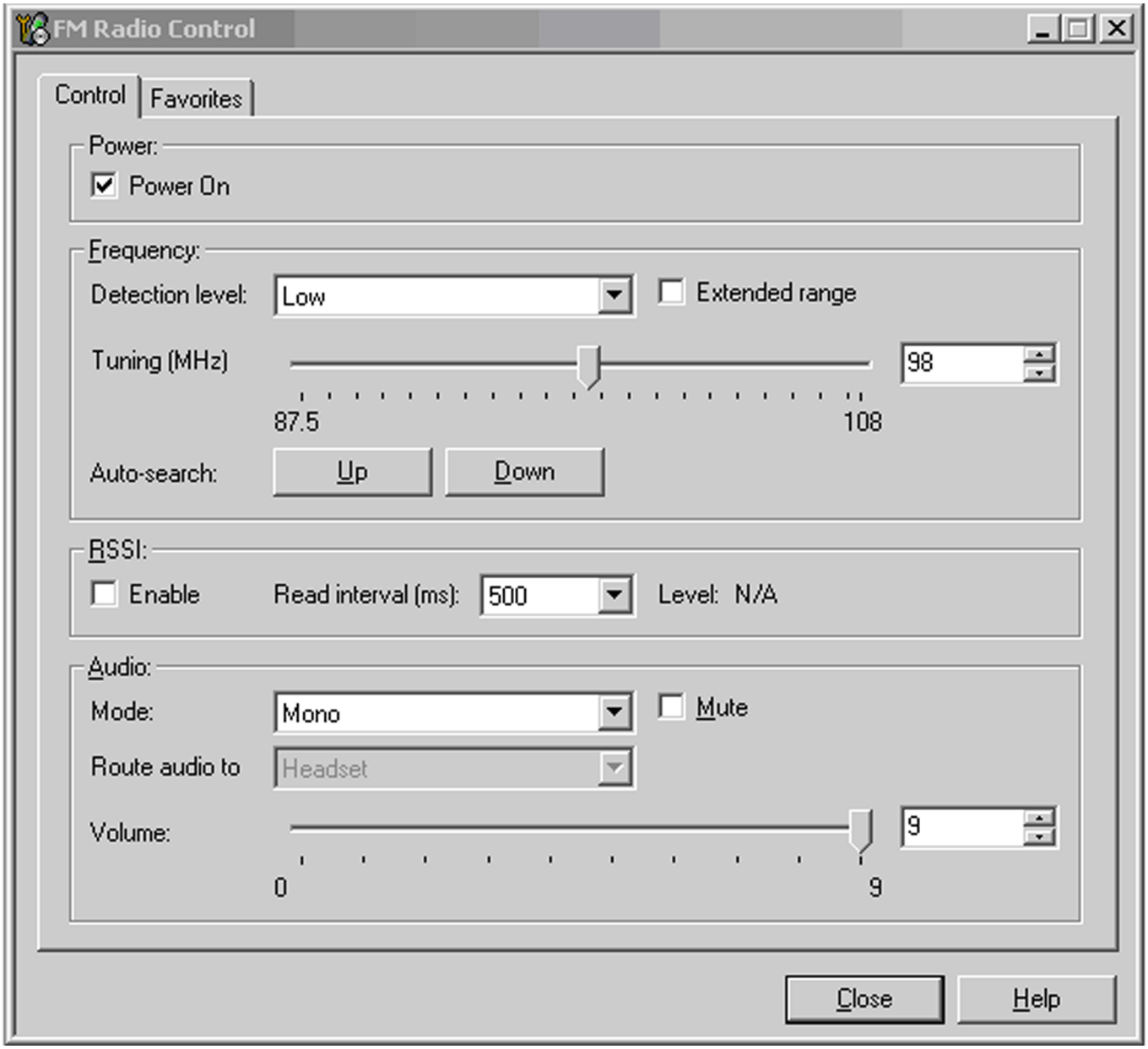


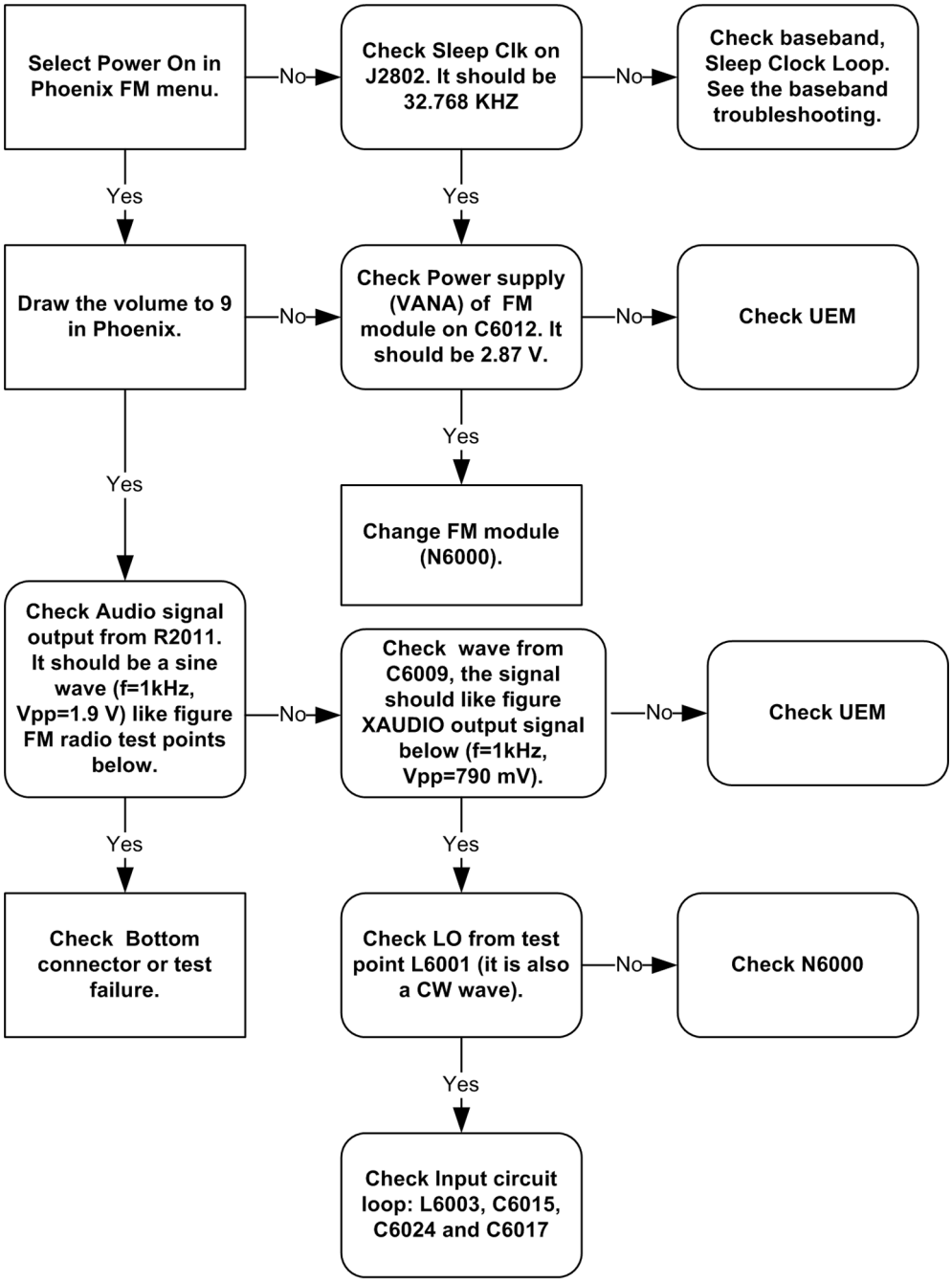

**Figure 82 Phoenix settings**

4. Establish input of a standard FM signal to the FM module.
5. Signal generator settings shall be as follows:
   - i Frequency: 98 MHz
   - ii Level: - 60 dBm
   - iii FM deviation: 75 kHz
   - iv LFGEN frequency: 1 kHZ


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## Troubleshooting diagram for FM radio

### Troubleshooting flow



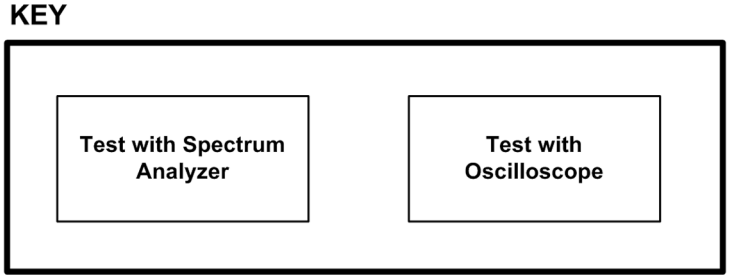




Figure 83 FM radio troubleshooting diagram


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## Bluetooth and FM radio test points

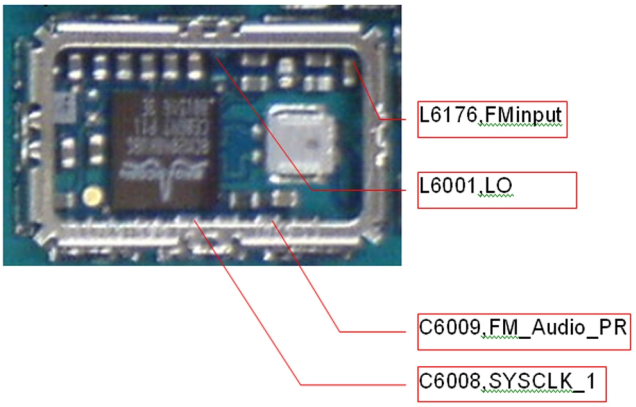



**Figure 84 Bluetooth and FM radio test points**

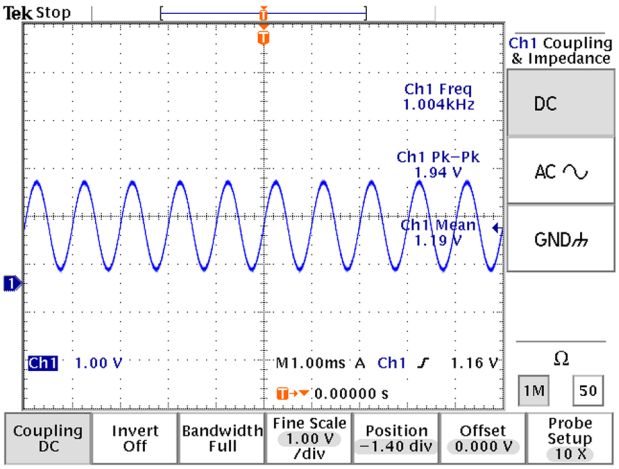



**Figure 85 XAUDIO output signal**

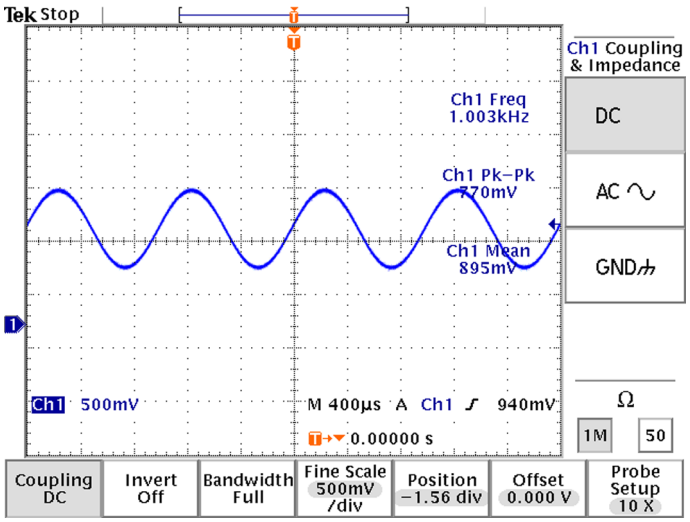



**Figure 86 FM module output signal**


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## Introduction to Bluetooth troubleshooting

There are two main Bluetooth (BT) problems that can occur:

| Problem | Description |
|---|---|
| Detachment of the BT antenna. | This would most likely happen if the device has been dropped repeatedly to the ground. It could cause the BT antenna to become loose or partially detached from the PWB. |
| A malfunction in the BT ASIC, BB ASICs or the phone's BT SMD components. | This is unpredictable and could have many causes i.e. SW or HW related. |

The main issue is to find out if the problem is related to the BT antenna or related to the BT system or the phone's BB and then replace/fix the faulty component. For location of the antenna, please refer to the exploded view in the Parts and layouts section.

## Bluetooth settings for Phoenix

### Steps

1. Start *Phoenix* service software.
2. From the **File** menu, choose **Open Product**, and then choose the correct type designator from the **Product** list.
3. Place the phone to a flash adapter in the local mode.
4. Choose **Testing→Bluetooth LOCALS** .
5. Locate JBT-9's serial number (12 digits) found in the type label on the back of JBT-9.

   In addition to JBT-9, also SB-6, JBT-3 and JBT-6 Bluetooth test boxes can be used.
6. In the *Bluetooth LOCALS* window, write the 12-digit serial number on the **Counterpart BT Device Address** line.

   This needs to be done only once provided that JBT-9 is not changed.
7. Place the JBT-9 box near (within 10 cm) the BT antenna and click **Run BER Test**.

### Results

Bit Error Rate test result is displayed in the *Bit Error Rate (BER) Tests* pane in the *Bluetooth LOCALS* window.


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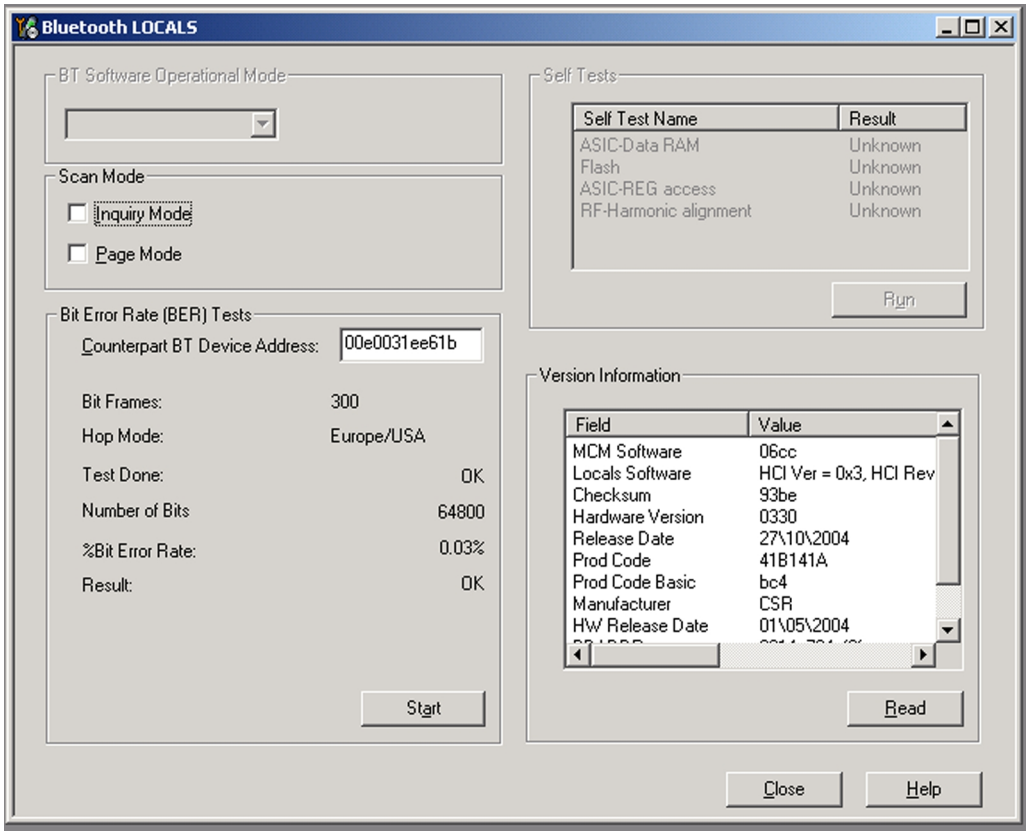



**Figure 87 BER test result**

## Bluetooth self tests in Phoenix

### Steps

1. Start *Phoenix* service software.
2. Choose**File→Scan Product.**
3. Place the phone to a flash adapter.
4. From the **Mode** drop-down menu, set mode to **Local**.
5. Choose **Testing→Self Tests.**
6. In the *Self Tests* window check the following Bluetooth related tests:
   - **ST_LPRF_IF_TEST**
   - **ST_LPRF_AUDIO_LINES_TEST**
   - **ST_BT_WAKEUP_TEST**


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7. To run the tests, click **Start**.

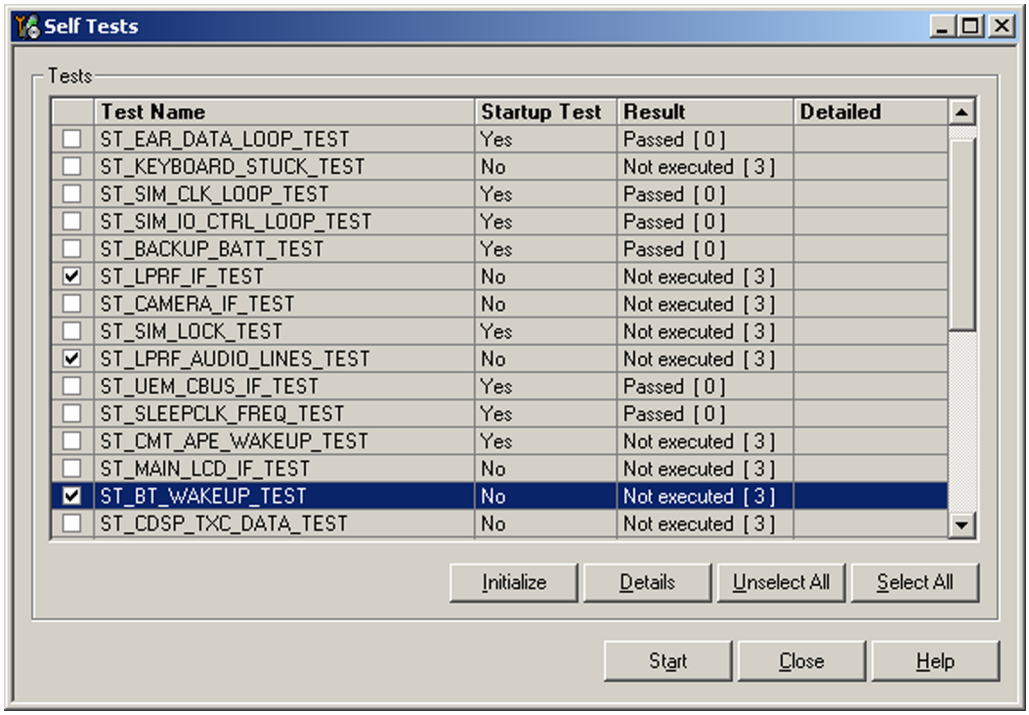



**Figure 88 Bluetooth self tests in *Phoenix***

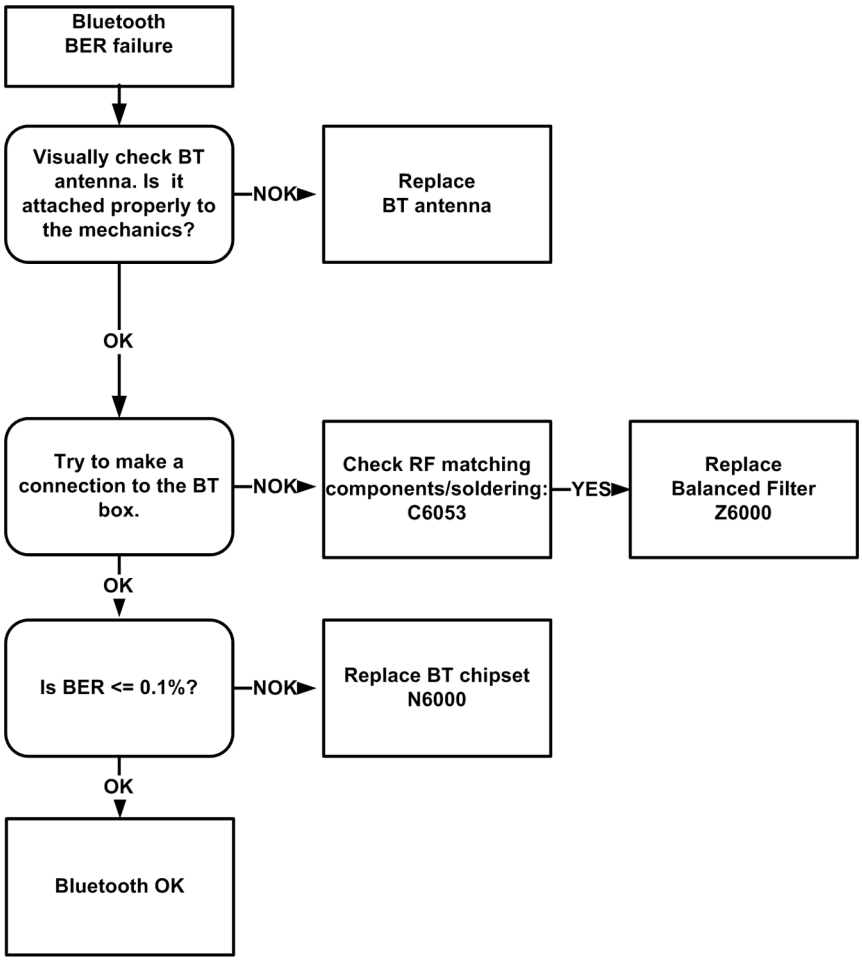
## Bluetooth BER failure troubleshooting

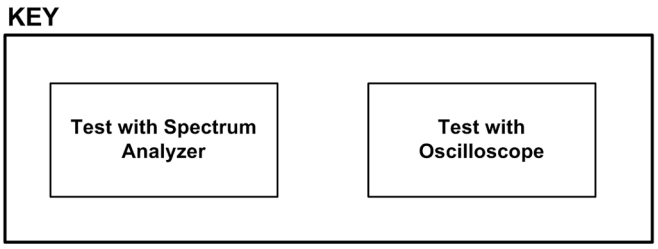
### Context

Basic encoding rules, BER, is a self-identifying and self-delimiting encoding scheme, which means that each data value can be identified, extracted and decoded individually.


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## Bluetooth circuit troubleshooting diagram





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# Antenna troubleshooting

## Antenna troubleshooting diagram

### Troubleshooting flow

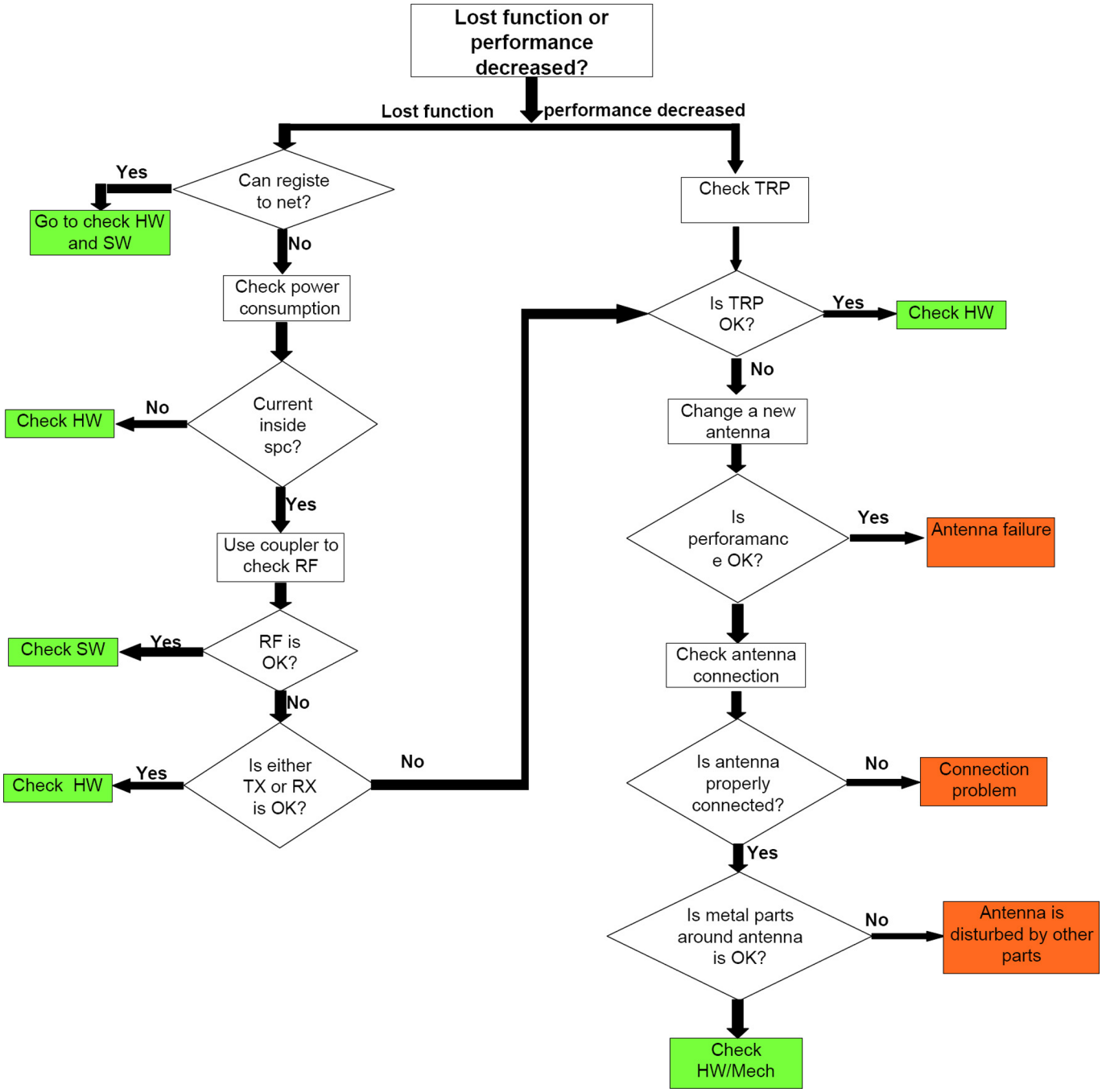



**Figure 89 Antenna troubleshooting**


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# 5 — Camera Module Troubleshooting


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# Introduction to camera module troubleshooting

## Background, tools and terminology

Faults or complaints in camera operation can be roughly categorised into three subgroups:

1 Camera is not functional at all; no image can be taken.

2 Images can be taken but there is nothing recognizable in them.

3 Images can be taken and they are recognizable but for some reason the quality of images is seriously degraded.

Image quality is very hard to measure quantitatively, and even comparative measurements are difficult (comparing two images) to do, if the difference is small. Especially if the user is not satisfied with his/her device's image quality, and tells, for example, that the images are not sharp, it is fairly difficult to accurately test the device and get an exact figure which would tell whether the device is functioning properly.

Often subjective evaluation has to be used for finding out if a certain property of the camera is acceptable or not. Some training or experience of a correctly operating reference device may be needed in order to detect what actually is wrong.

It is easy for the user to take bad images in bad conditions. Therefore the camera operation has to be checked always in constant conditions (lighting, temperature) or by using a second, known-to-be good device as reference.

When checking for possible errors in camera functionality, knowing what error is suspected significantly helps the testing by narrowing down the amount of test cases. The following types of image quality problems may be expected to appear:

- Dust (black spots)
- Lack of sharpness
- Bit errors

## Terms

| | |
|---|---|
| *Dynamic range* | Camera's ability to capture details in dark and bright areas of the scene simultaneously. |
| *Exposure time* | Camera modules use silicon sensor to collect light and for forming an image. The imaging process roughly corresponds to traditional film photography, in which exposure time means the time during which the film is exposed to light coming through optics. Increasing the time will allow for more light hitting the film and thus results in brighter image. The operation principle is exactly the same with silicon sensor, but the shutter functionality is handled electronically i.e. there is no mechanical moving parts like in film cameras. |
| *Flicker* | Phenomenon, which is caused by pulsating in scene lighting, typically appearing as wide horizontal stripes in an image. |
| *Noise* | Variation of response between pixels with same level of input illumination. |
| *Resolution* | Usually the amount of pixels in the camera sensor; for example, RM-298/299 has a 640 x 480 pixel sensor resolution. In some occasions the term resolution is used for describing the sharpness of the images. |


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| | |
|---|---|
| *Sensitivity* | Camera module's sensitivity to light. In equivalent illumination conditions, a less sensitive camera needs a longer exposure time to gather enough light in forming a good image. Analogous to ISO speed in photographic film. |
| *Sharpness* | Good quality images are 'sharp' or 'crisp', meaning that image details are well visible in the picture. However, certain issues, such as non-idealities in optics or high levels of digital zoom, cause image blurring, making objects in picture to appear 'soft'. Each camera type typically has its own level of performance. |

## The effect of image taking conditions on image quality

There are some factors, which may cause poor image quality, if not taken into account by the end user when shooting images, and thus may result in complaints. The items listed are normal to camera operation and are not a reason for changing the camera module.

### Distance to target

The lens in the module is specified to operate satisfactorily from 20 cm to infinite distance of scene objects. In practice, the operation is such that close objects may be noticed to get more blurred when distance to them is shorter than 20 cm. The lack of sharpness is first visible in full resolution images. If observing just the viewfinder, even very close objects may seem to appear sharp. This is normal; do not change the camera module.




**Figure 90 Blurred image. Target too close.**

### The amount of light available

In dim conditions camera runs out of sensitivity. The exposure time is long (especially in the night mode) and the risk of getting shaken (= blurred) images increases. In addition, image noise level grows. The maximum exposure time in the night mode is ¼ seconds. Therefore, images need to be taken with extreme care and by supporting the phone when the amount of light reflected from the target is low. Because of the longer exposure time and larger gain value, noise level increases in low light conditions. Sometimes blurring may even occur in daytime, if the image is taken very carelessly. See the figure below for an example. This is normal; do not change the camera module.


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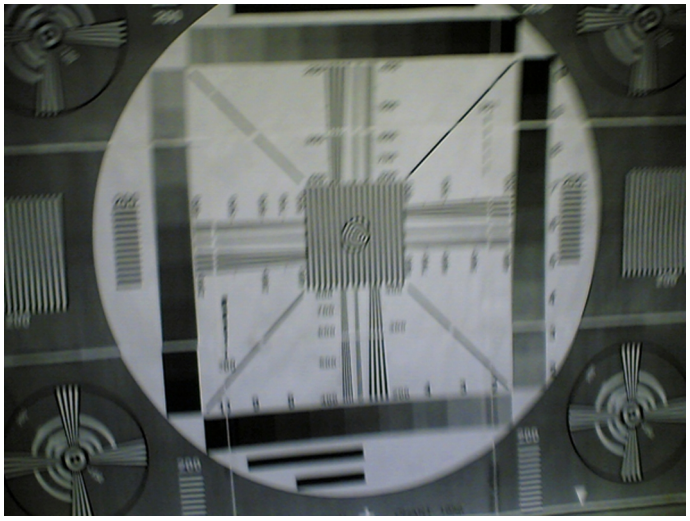


**Figure 91 Blurring caused by shaking hands**

## Movement in bright light

If an image is taken of moving objects or if the device is used in a moving vehicle, object 'skewing' or 'tilting' may occur. This phenomenon is fundamental to most CMOS camera types, and usually cannot be avoided. The movement of camera or object sometimes cause blurring indoors or in dim lighting conditions because of long exposure time. This is normal; do not change the camera module.



**Figure 92 Near objects get skewed when taking images from a moving vehicle**


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## Temperature

High temperatures inside the mobile phone cause more noise to appear in images. For example, in +70 degrees (Celsius), the noise level may be very high, and it further grows if the conditions are dim. If the phone processor has been heavily loaded for a long time before taking an image, the phone might have considerably higher temperature inside than in the surrounding environment. This is also normal to camera operation; do not change the camera module.




**Figure 93 Noisy image taken in +70 degrees Celsius**

## Phone display

If the display contrast is set too dark, the image quality degrades: the images may be very dark depending on the setting. If the display contrast is set too bright, image contrast appears bad and "faint". This problem is solved by setting the display contrast correctly. This is normal behaviour; do not change the camera module.

## Basic rules of photography (especially shooting against light)

Because of dynamic range limitations, taking images against bright light might cause either saturated image or the actual target appear too dark. In practice, this means that when taking an image indoors and having, for example, a window behind the object, the result is usually poor. This is normal behaviour; do not change the camera module.

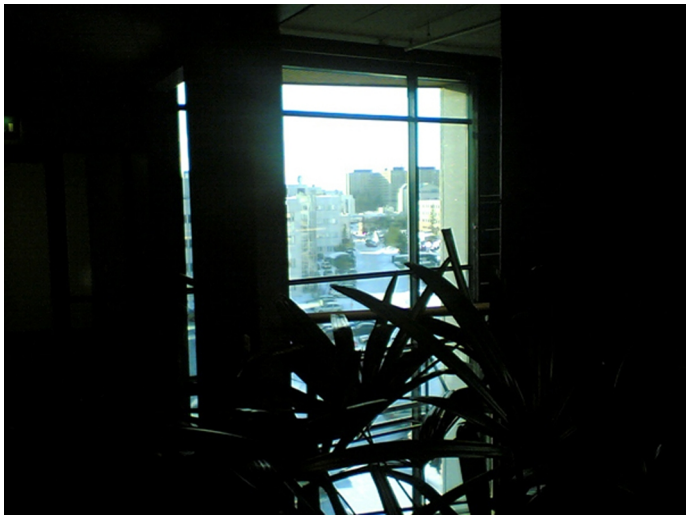


**Figure 94 Image taken against light**


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## Flicker

In some occasions a bright fluorescent light may cause flicker in the viewfinder and captured image. This phenomenon may also be a result, if images are taken indoors under the mismatch of 50/60 Hz electricity network frequency. The electricity frequency used is automatically detected by the camera module. In some very few countries, both 50 and 60 Hz networks are present and thus probability for the phenomenon increases. Flickering occurs also under high artificial illumination level. This is normal behaviour; do not change the camera module.



**Figure 95 Flicker in an image; object illuminated by strong fluorescent light**

## Bright light outside of image view

Especially the sun can cause clearly visible lens glare phenomenon and poor contrast in images. This happens because of undesired reflections inside the camera optics. Generally this kind of reflections are common in all optical systems. This is normal behaviour; do not change the camera module.



**Figure 96 A lens reflection effect caused by sunshine**


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## Examples of good quality images



**Figure 97 Good image taken indoors**



**Figure 98 Good image taken outdoors**

## Camera construction

This section describes the mechanical construction of the camera module for getting a better understanding of the actual mechanical structure of the module.

**Table 7 Camera specifications**

| | |
|---|---|
| Sensor type | CMOS Sensor |
| Photo detectors | 0.3 million |
| F number/Aperture | f/2.8 |
| Focal length | 1.78 mm |
| Focus range | 20 cm to infinity |
| Still Image resolutions | 640x480, 320x240, 160x120 |
| Still images file format | EXIF (JPEG), *.jpg |


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| | |
|---|---|
| Video resolutions | 128x96, at 13 frames per second |
| Video clip length | 9 seconds or free, maximal clip length in free mode is 2 minutes (limited by the data storing capabilities of the device) |
| Video file format | 3GPP, *.3gp |
| Exposure | Automatic |
| White Balance | Automatic |
| Colours | 16.7 million / 24-bit |
| Capture Modes | Night mode, Sequence mode, self timer |

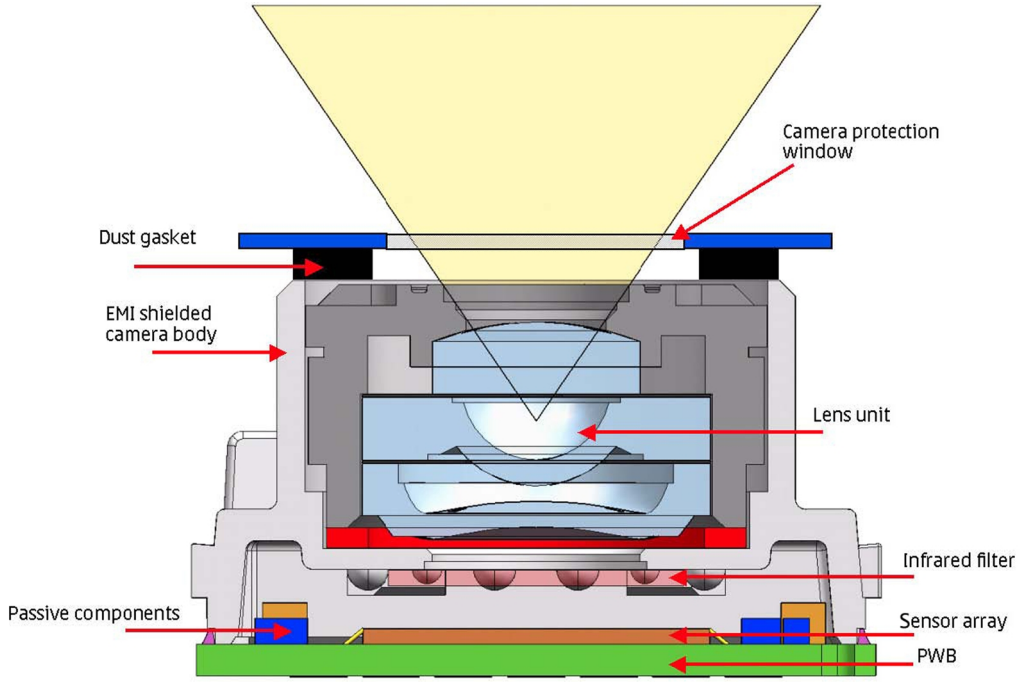



**Figure 99 Camera module cross section and assembly principle**


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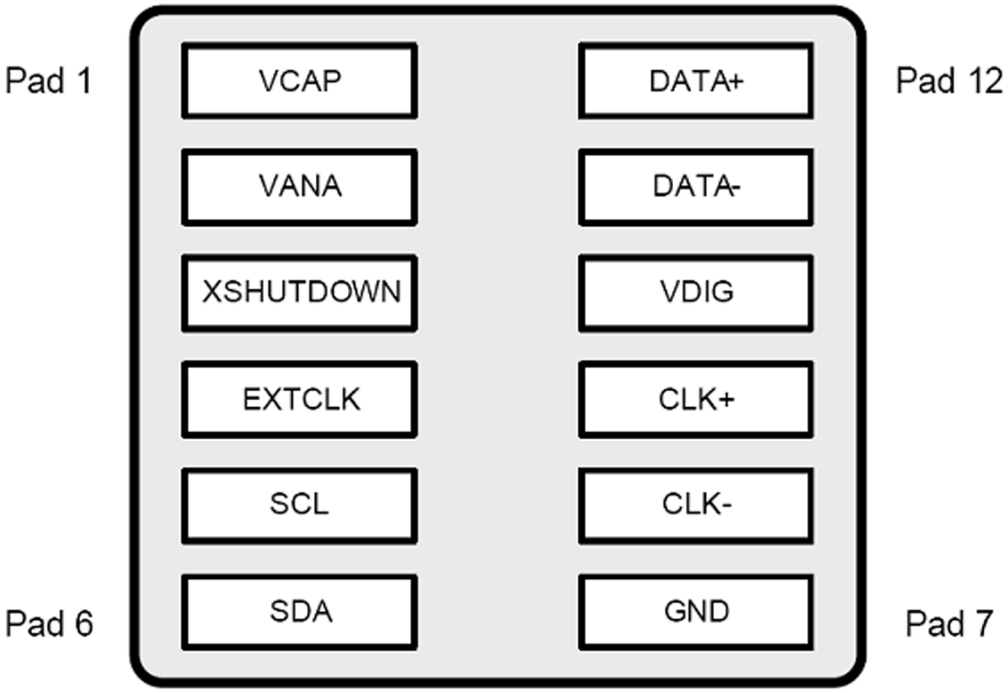



**Figure 100 Camera module bottom view including serial numbering**

The camera module as a component is not a repairable part, meaning that the components inside the module may not be changed. Cleaning dust from the front face is allowed only. Use clean compressed air.

The camera module uses socket type connecting. For versioning, laser marked serial numbering is used on the PWB.

The main parts of the module are:

- Lens unit including lens aperture.
- Infrared filter; used to prevent infrared light from contaminating the image colours. The IR filter is glued to the EMI shielded camera body.
- Camera body; made of conductive metallized plastic and attached to the PWB with glue.
- Sensor array including DSP functions is glued and wire-bonded to the PWB.
- PWB, FR-4 type
- Passive components
- Camera protection window; part of the phone cover mechanics
- Dust gasket between the lens unit and camera protection window

## Dynamic camera configuration

DCC (Dynamic Camera Configuration) is a system to allow final camera tuning values to be programmed on Service Centre. DCC data generated for a camera hardware is set by Camera Entity IQ department and placed into global DCC settings database. Service centres could replace a defective module with a spare one to get camera function recovered by updating DCC data.

### DCC data update instruction

Service software is used to update DCC data when camera configuration (a camera or a hardware accelerator) of the terminal has been changed. Service software DCC update feature reads camera configuration identification from the terminal, selects a new configuration data file from DP (data package) and writes data into the memory of the terminal during the process. If the update fails, new camera configuration installed into the terminal is not supported by DP. Always update DCC when a camera or a HWA has been changed.


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In Service software press “Read”, and the Camera Configuration window shows available DCC data file name and its version to upload. If the previous camera configuration was the same as installed, then Current Configuration Version displays DCC data version currently in the terminal memory, otherwise it shows xxx.xxx. Press “Upload” and then the DCC data settings are updated.

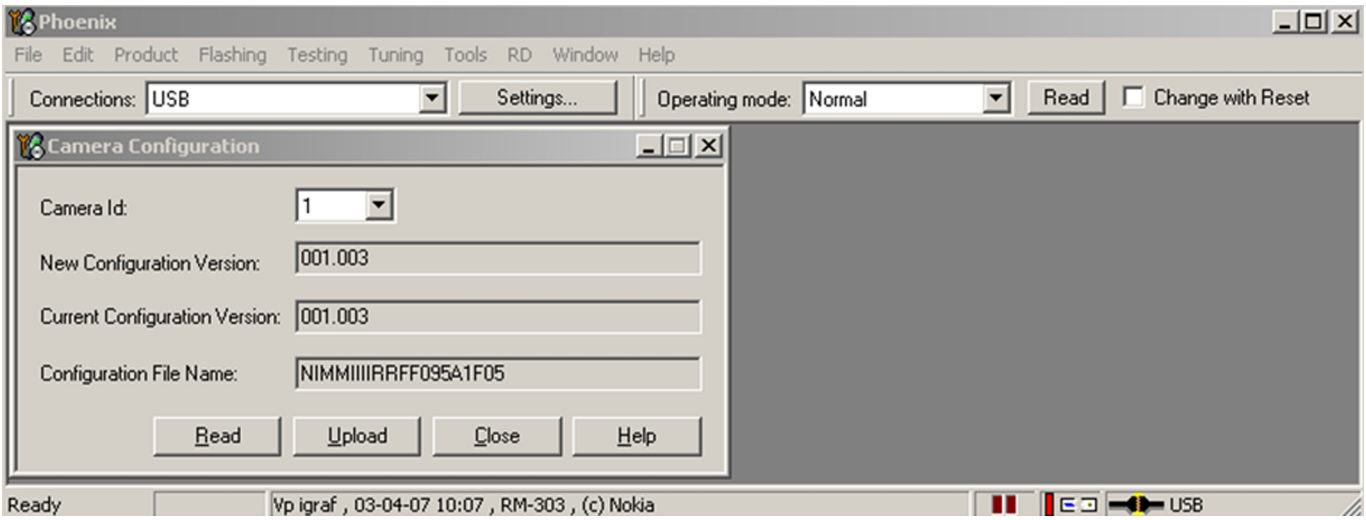



**Figure 101 DCC data update**

## Image quality analysis

### Testing for dust in camera module

#### Symptoms and diagnosis

For detecting these kinds of problems, take an image of a uniform white surface and analyse it in full resolution. A good quality PC monitor is preferred for analysis. Search carefully, since finding these defects is not always easy. Figure "Effects of dust on optical path" is an example image containing easily detectable dust problems.

When taking a white image, use uniformly lightened white paper or white wall. One possibility is to use uniform light but in this case make sure that the camera image is not flickering when taking the test image. In case flickering happens, try to reduce illumination level. Use JPEG image format for analysing, and set the image quality parameter to ‘High Quality’.

Black spots in an image are caused by dirt particles trapped inside the optical system. Clearly visible and sharp edged black dots in an image are typically dust particles on the image sensor. These spots are searched for in the manufacturing phase, but it is possible that the camera body cavity contains a particle, which may move onto the image sensor active surface, for example, when the phone is dropped. Thus it is also possible that the problem will disappear before the phone is brought to service. The camera should be replaced if the problem is present when the service technician analyses the phone.

If a dust particle is lying on the infrared filter surface on either side, they are hard to locate because they are out of focus, and appear in the image as large, grayish and fading-edge 'blobs'. Sometimes they are invisible to the eye, and thus the user probably does not notice them at all. However, it is possible that a larger particle disturbs the user, causing need for service.


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**Figure 102 Effects of dust on optical path**

If large dust particles get trapped on top of the lens surface in the cavity between camera window and lens, they will cause image blurring and poor contrast. The dust gasket between the window and lens should prevent any particles from getting into the cavity after the manufacturing phase. Dust in this position should be blown away by using compressed air.

Unauthorized disassembling of the product can also be the root of the problem. However, in most cases it should be possible to remove the particle(s) by using clean compressed air. Never wipe the lens surface before trying compressed air; the possibility of damaging the lens is substantial. Always check the image sharpness after removing dust.

## Testing camera image sharpness

### Symptoms and diagnosis

If pictures taken with a device are claimed to be blurry, there are six possible sources for the problem:

1 The protection window is fingerprinted, soiled, dirty, visibly scratched or broken.

2 The photographed object is too close – the camera lens operates with distances from 20 cm to infinity. This is no cause to replace camera module.

3 User has tried to take pictures in too dark conditions, and images are blurred due to handshake or movement. This is no cause to replace camera module.

4 There is dirt between the protection window and camera lens.


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5 The protection window is defective. This can be either a manufacturing failure or caused by the user. The window should be changed.

6 The camera lens is misfocused because of a manufacturing error.

7 Very high level of digital zoom is used

A quantitative analysis of sharpness is very difficult to conduct in any other environment than optics laboratory. Therefore, subjective analysis should be used.

If no visible defects (items 1-4) are found, a couple of test images should be taken. Generally, a well-illuminated typical indoor scene can be used as a target. The main considerations are:

- The protection window has to be clean.
- The amount of light (300 – 600 lux (bright office lighting)) is sufficient.
- The scene should contain, for example, small objects for checking sharpness. Their distance should be 1 – 2 meters.
- If possible, compare the image to another image of the same scene, taken with a different device. Note that the reference device has to be a similar Nokia phone.

## Steps

1. Take several images of small objects in the distance of 1-2 metres.
2. Analyse the images on a PC screen at 100% scaling with the reference images.

   Pay attention to the computer display settings: at least 65000 colors (16-bit) have to be used. True colour (24-bit, 16 million colours) or 32-bit (full colour) setting is recommended.

## Next actions

If there appears to be a clearly noticeable difference between the reference image and the test images, the module might have a misfocused lens -> change the module.

Re-check the resolution after changing the camera module.

If the changed module produces the same result, the fault is probably in the camera window. Check the window by looking carefully through it when replacing the module.

### Dirty camera lens protection window

The following series of images demonstrates the effects of fingerprints on the camera protection window.

It should be noted that the effects of any dirt in images can vary much. It may be difficult to judge whether the window has been dirty or if something else is wrong. Therefore, the cleanness of the protection window should always be checked and the window should be wiped clean with a suitable cloth.

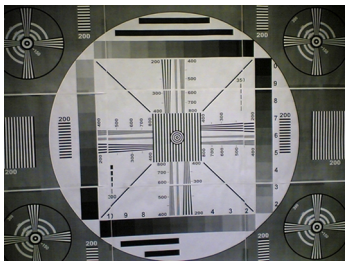


**Figure 103 Image taken with clean protection window**

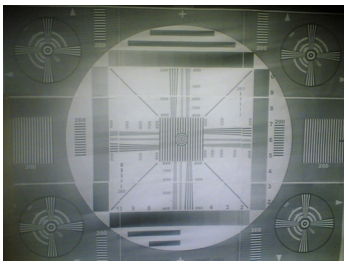


**Figure 104 Image taken with greasy protection window**

### Image bit errors

Bit errors are image defects caused by data transmission errors between the camera module and the phone baseband and/or errors inside the module.


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Usually bit errors can be easily detected in images, and they are best visible in full resolution images. A good practice is to use a uniform white test target when analysing these errors. The errors are clearly visible, colourful sharp dots or lines in camera images. See the following figure.




**Figure 105 Bit errors caused by JPEG compression**

One type of bit error is a lack of bit depth. In this case, the image is almost totally black under normal conditions, and only senses something in very highly illuminated environments. Typically this is a contact problem between the camera module and the phone main PWB. Very black images and viewfinder may also be caused by failure of the 2.8V supply to the camera. You should check the camera assembly and connector contacts.

If the fault is in the camera module, bit errors are typically visible only when using some specific image resolution. For example, in case of a viewfinder fault, the error might exist but is not visible in a full size image.

## Camera troubleshooting flowcharts

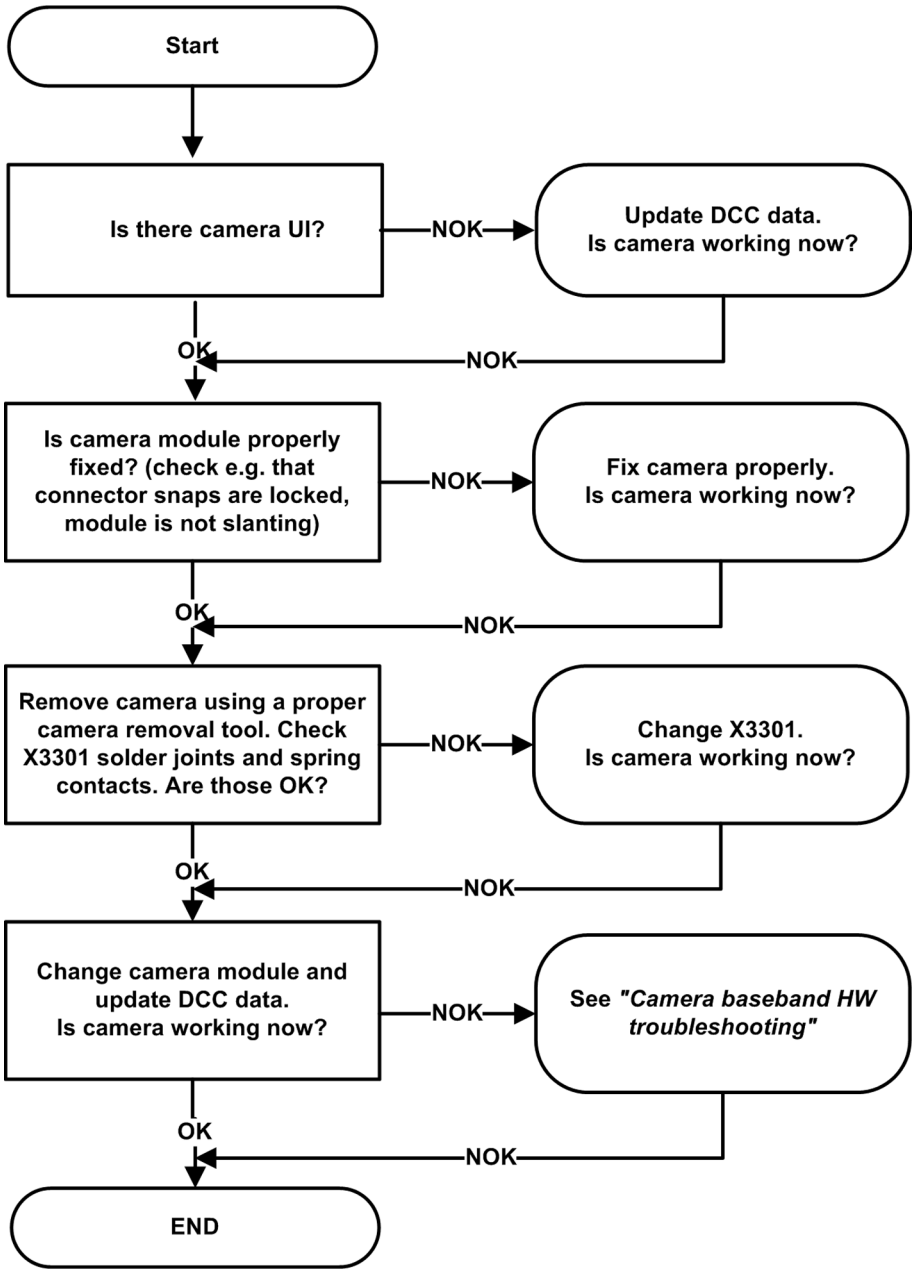
### Camera hardware failure message troubleshooting

#### Context

If you get a hardware failure message when using the camera, follow the next troubleshooting flowchart.


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## Troubleshooting flow



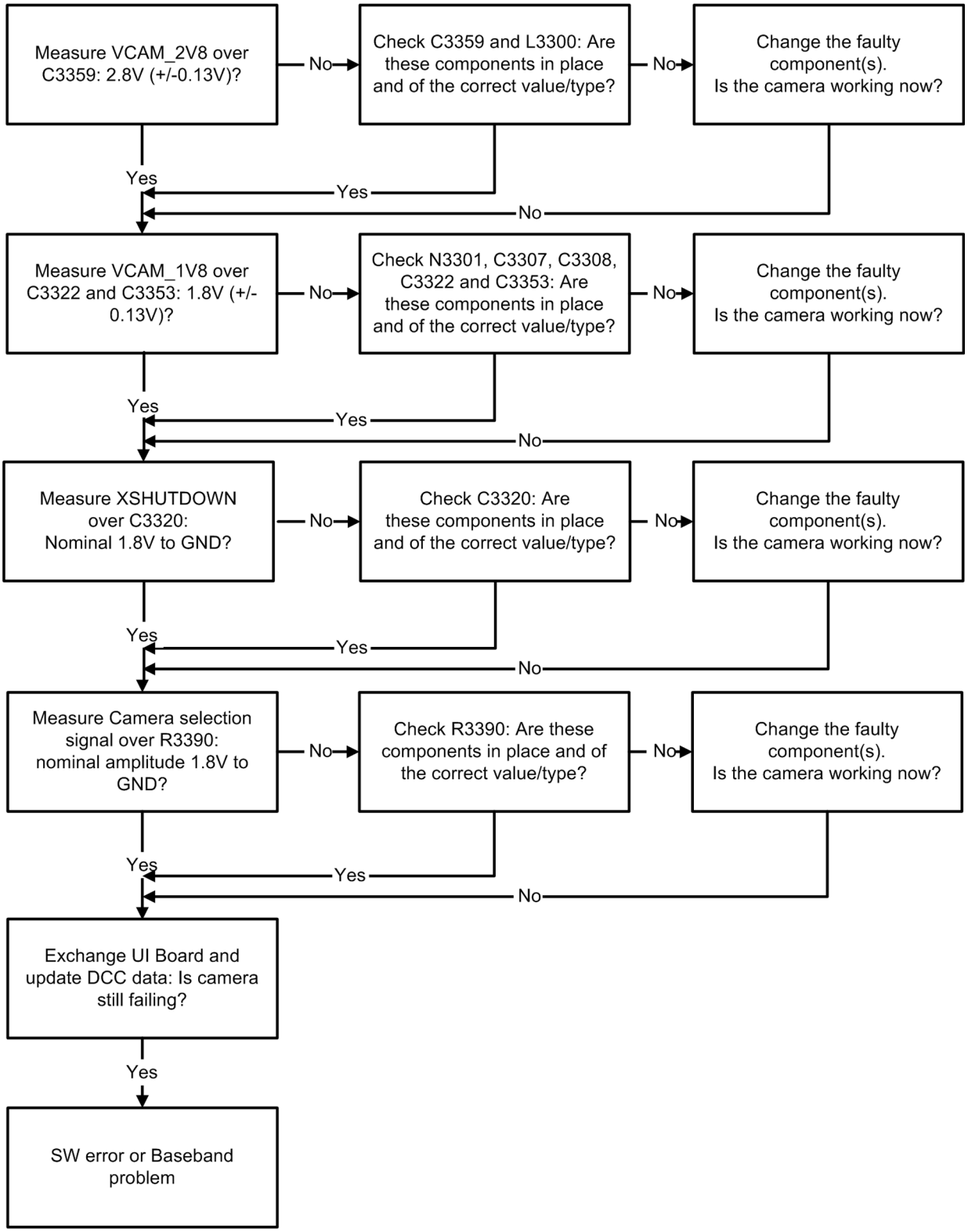

**Note:** Make sure that the phone has the latest software before continuing.


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## Camera baseband HW troubleshooting

### Troubleshooting flow

Note: the camera application must be activated for any camera signals including voltages to be present

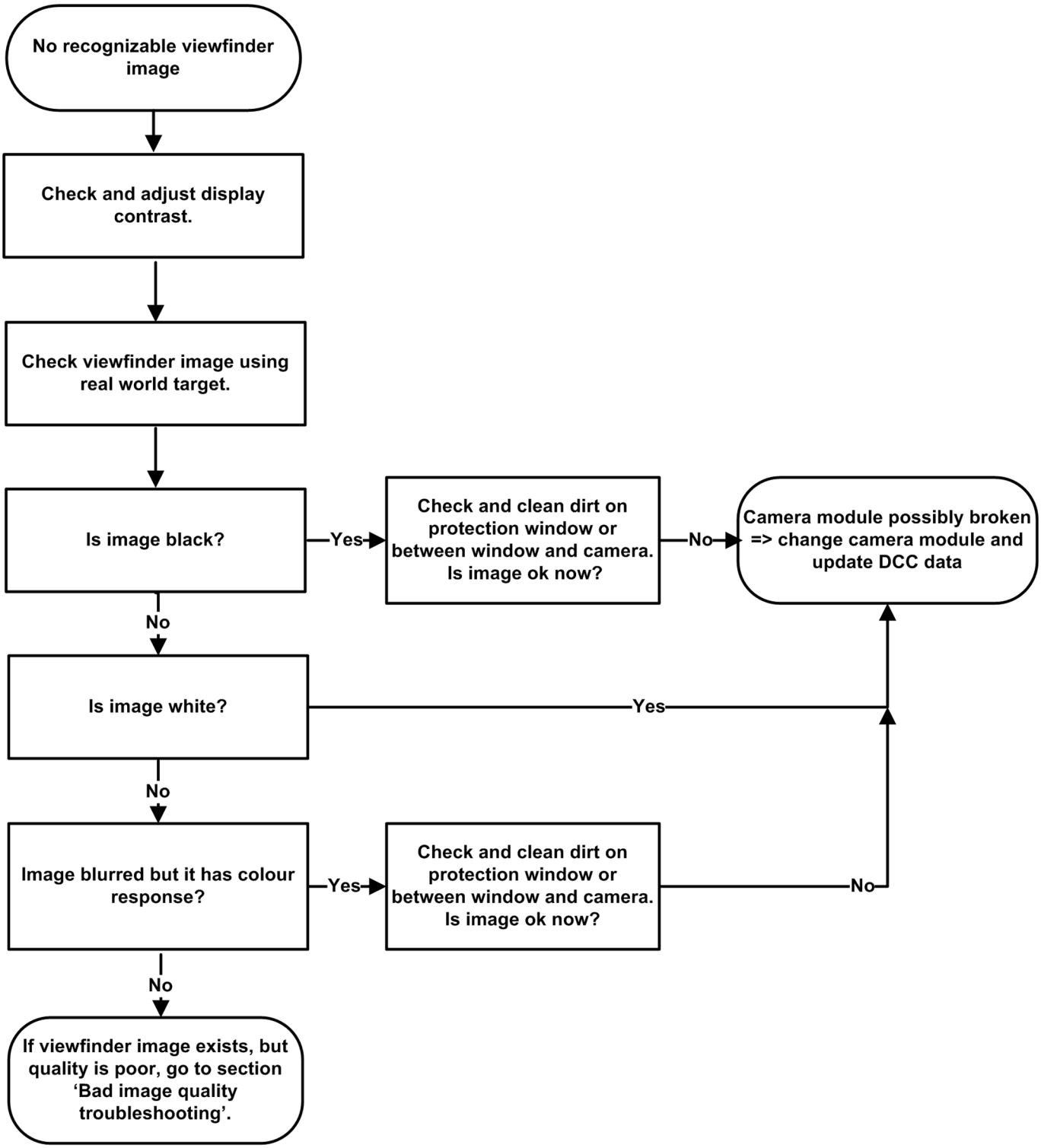




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## Camera viewfinder troubleshooting

### Troubleshooting flow

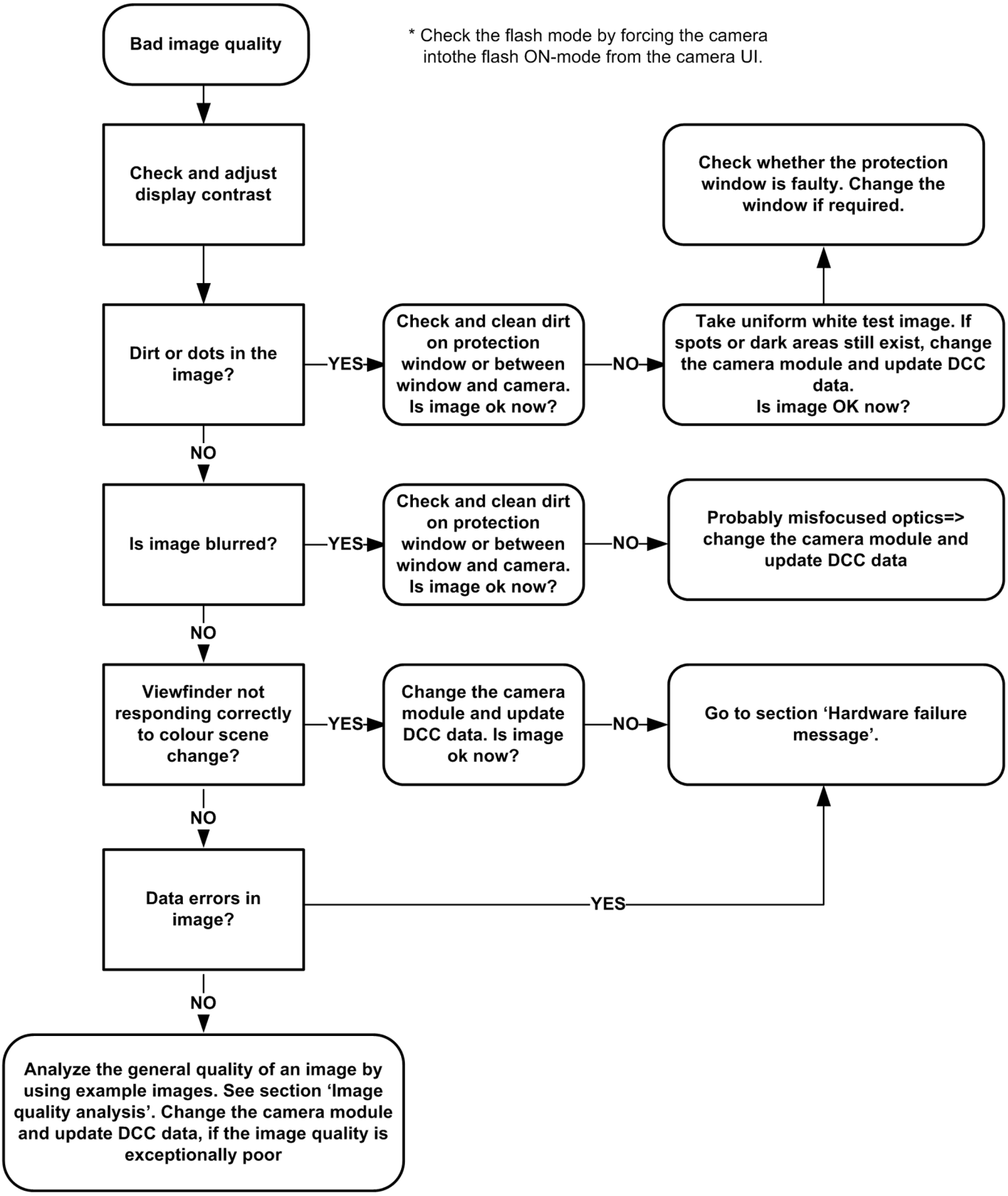




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## Bad camera image quality troubleshooting

### Troubleshooting flow





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# 6 — System Module


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## System module block diagram

The main board consists of a radio frequency part and a baseband part. The User Interface parts are situated at the UI side, which is on the opposite side of the engine board. The 2CP is the engine module of the mobile device, and the 2CQ is the UI module of module of the mobile device.

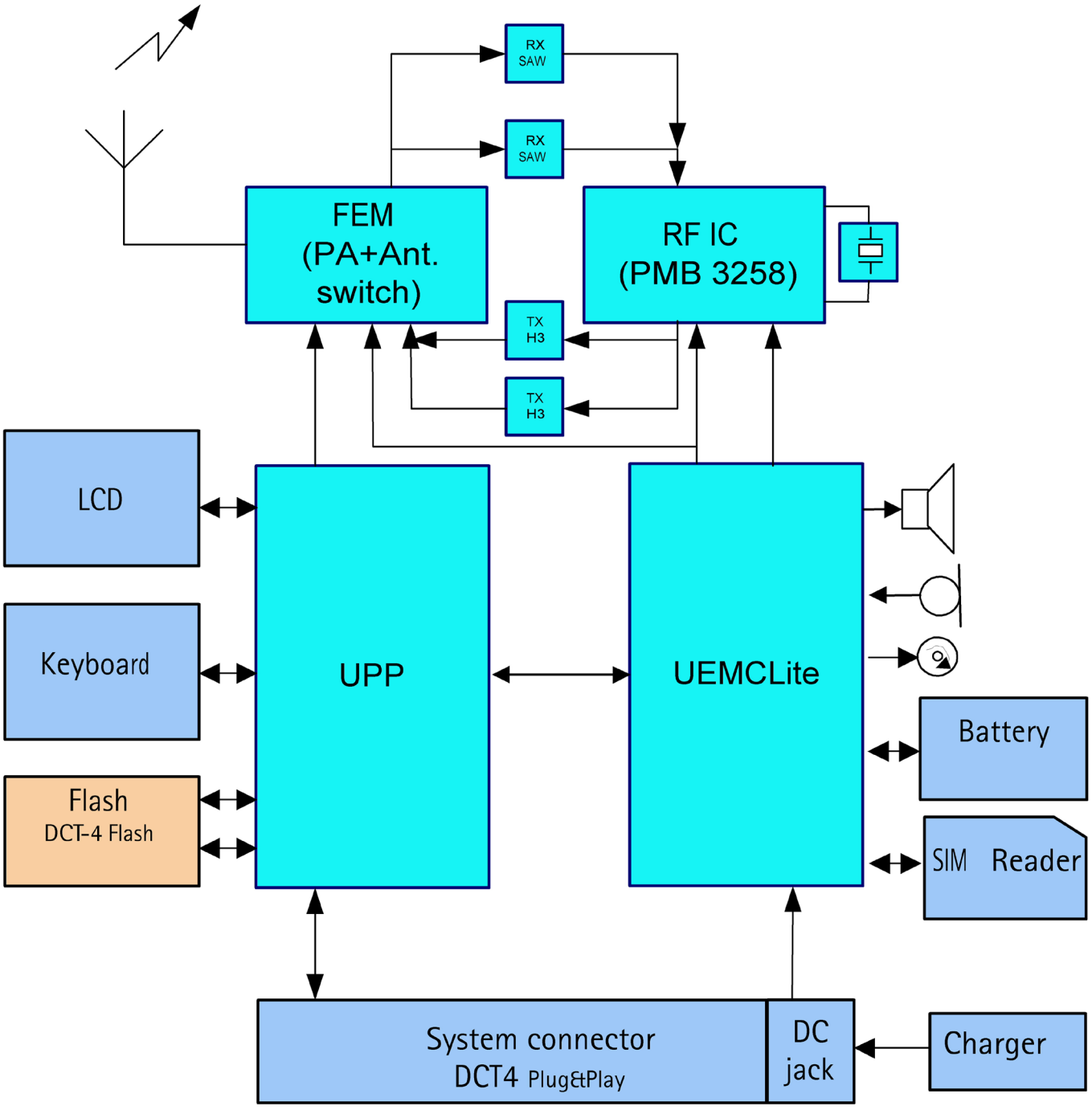



**Figure 106 Module block diagram**


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# Baseband description

## Functional description

The BB core is based on UPP8M CPU. UPP8M takes care of all the signal processing and operation controlling tasks of the mobile device. For power management, there is one main ASIC for controlling charging and supplying power UEMCLite plus a discrete power supply. The main reset for the system is generated by the UEMCLite. The memory comprises of 128 Mbit flash and 16 Mbit PsRAM. memory devices that are stacked on top of each other in a single Combo package.

The interface to the RF and audio sections is also handled by the UEMCLite. This ASIC provides A/D and D/A conversion of the in-phase and quadrature receive and transmit signal paths and also A/D and D/A conversions of received and transmitted audio signals. Data transmission between UEMCLite and RF and the UPP8M is implemented using different serial connections (CBUS, DBUS and RFBUS). Digital speech processing is handled by UPP8M ASIC.

A real time clock function is integrated into UEMCLite, which utilizes the same 32 kHz-clock source as the sleep clock. The SLCK/RTC runs all time when the phone battery is connected. It is running also when the phone is switched off. In UEMCLite there is no back up battery/capacitor connection.

There are three audio transducers in the product; 16 mm speaker, an earpiece and a microphone. The earpiece is used to generate audios for earpiece; the speaker is used to generate audios for IHF and ringing tones. A separate audio amplifier drives the speaker. There is only one microphone for both HS and IHF modes.

The display is an TFT type color display with 65536 colors and 128 x 160 pixels with backlighting. The keypad module features a function keymat with a 4-way navigation key with a center selection key.

### UPP

UPP (Universal Phone Processor) is the digital ASIC of the DCT4 generation base band. UPP8M includes 4.5 MBit internal RAM, 16/32-bit RISC MCU core. UPP8Mv6.11 includes ARM7TDMI rev4 16/32-bit RISC MCU core, TI Lead3 16-bit DSP phase2+ core with DMA controller, ROM for MCU boot code and all digital control logic.

### Memory

This mobile uses two kinds of memories, Flash and Synchronous RAM (SRAM). These memories have are sharing the same bus interface to UPP8M. SDRAM is used as the working memory. The SRAM size is 16 Mbits.

SRAM I/O is 1.8 V and core 1.8 V supplied by UEMCLite regulator VIO. All memory contents are lost if the supply voltage is switched off.

Multiplexed flash memory interface is used to store the MCU program code and user data.

Configuration of flash memory is a 128 Mbit NOR flash memory. Flash I/O and core voltage are 1.8 V.

### UEMCLite

The UEMCLite is a low cost energy management ASIC contains for BB use two 2.78V LDO regulators, 1.8V linear regulator, programmable 1.0 - 1.5 V linear regulator and 1.8/3.0 V LDO regulator. For RF use UEMCLite has five 2.78 V LDOs. In addition, the UEMCLite contains audio codec, A/D converters, RF converters, many drivers, etc.

### External regulators

White LED Driver solution is implemented with DC/DC converter. The driver circuit is controlled by UEM output pin DLIGHT, which add external pull up using a digital transistor and one resistor. The schematics also combined the UEMIO (5) to control DC/DC enable as another optional using two jumper.


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## Energy management

### Filter components

The master of EM control is UEMCLite and with SW it has the main control of the system voltages and operating modes. The power distribution diagram is presented in the illustration below.

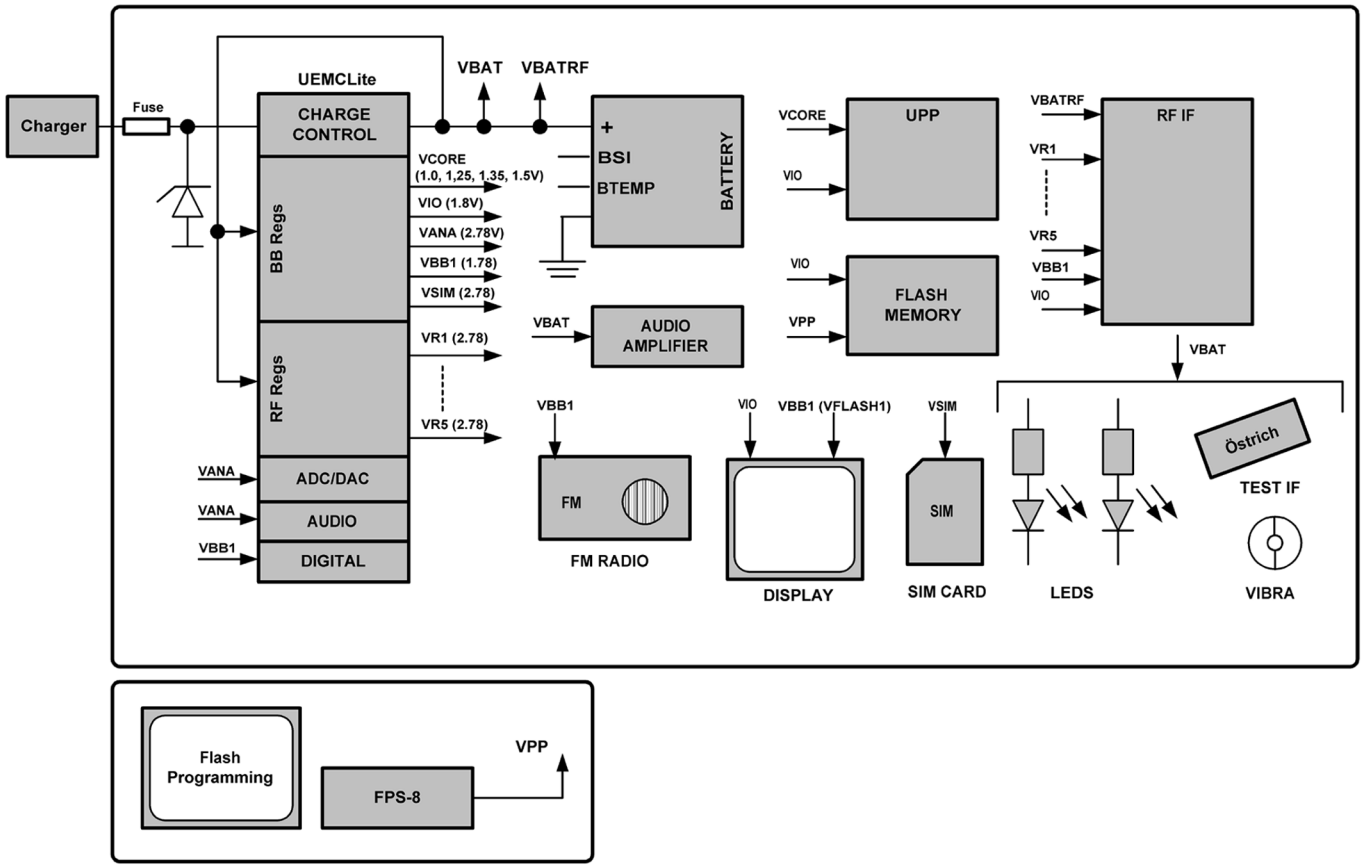



**Figure 107 Power connection diagram**

All connectors going to the "outside world" have filter components, ESD protection and EMC reduction. The Digital/Data lines on SIM have special dedicated filter ASIP. The below figure show the SIM filtering.

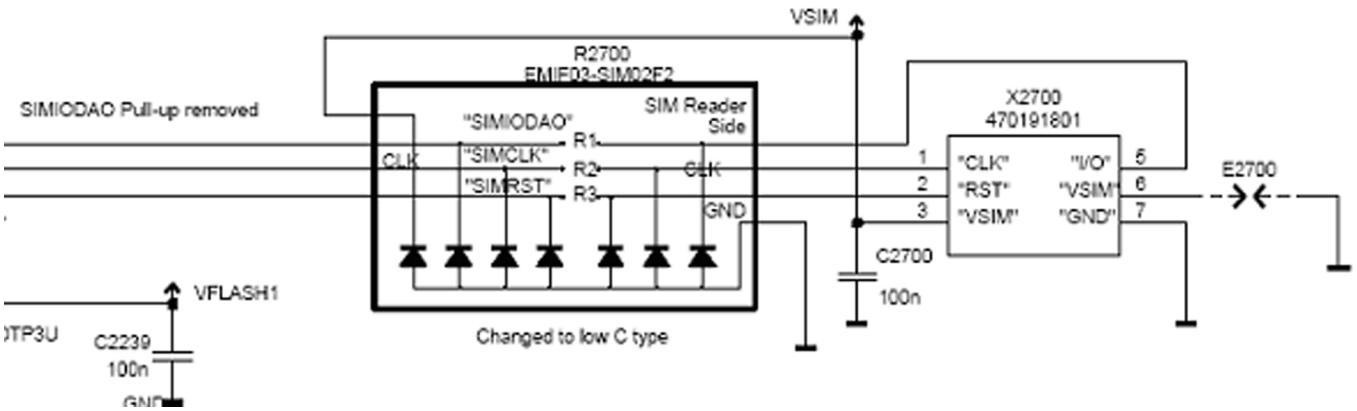



**Figure 108 SIM filtering**


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The Audio circuit: Earpiece, IHF, internal microphone and external speaker are filtered with discrete components (common mode reduction coils, Varistors, caps and resistors), where as the external microphone uses differential mode mic. ASIP

The 16 UEMECLite BB & RF regulators are specified to have a decoupling cap of 1 µF ±20%.

## Modes of operation

BB4.0 LiteV2 base band has five different functional modes, which are defined in UEMCLite specification:

- No supply: In NO_SUPPLY mode, the phone has no supply voltage. This mode is due to disconnection of main battery or low battery voltage level in battery. Phone is exiting from NO_SUPPLY mode when sufficient battery voltage level is detected. Battery voltage can rise either by connecting a new battery with VBAT > VMSTR+ or by connecting charger and charging the battery above VMSTR+.
- Acting Dead: If the phone is off when the charger is connected, the phone is powered on but enters a state called "Acting Dead". To the user, the phone acts as if it was switched off. A battery charging alert is given and/or a battery charging indication on the display is shown to acknowledge the user that the battery is being charged.
- Active: In the Active mode the phone is in normal operation, scanning for channels, listening to a base station, transmitting and processing information. There are several sub-states in the active mode depending on if the phone is in burst reception, burst transmission, if DSP is working etc.

  In Active mode the RF regulators are controlled by SW writing into UEMCLite's registers wanted settings: VR regulators can be disabled, enabled or forced into low quiescent current mode. VR2 is always enabled in Active mode for system clock chain supply
- Sleep: In sleep mode VCTCXO is shut down and 32 kHz sleep clock oscillator is used as reference clock for the base band.
- Charging: Charging can be performed in any operating mode. The battery type / size is indicated by a resistor inside the battery pack. The resistor value corresponds to a specific battery capacity. This capacity value is related to the battery technology as different capacity values are achieved by using different battery technology. The battery voltage, temperature, size and current are measured by the UEMCLite and controlled by the charging software running in the UPP. The charging control circuitry (CHACON) inside the UEMCLite controls the charging current delivered from the charger to the battery. The battery voltage rise is limited by turning the UEMCLite switch off when the battery voltage has reached 4.2 V. Charging current is monitored by measuring the voltage drop across a 220 mW resistor. The PWM output doesn't exist any more from UEMCLite to the bottom connector

## Voltage limits

**Table 8 Voltage limits**

| Parameter | Description | Value/V |
|---|---|---|
| Vmstr+ | Master reset threshold (rising) | 2.1 ±0.1 |
| Vmstr- | Master reset threshold (falling) | 1.9 ±0.1 |
| Vcoff+ | Hardware cutoff (rising) | 3.1 ±0.1 |
| Vcoff- | Hardware cutoff (falling) | 2.8 ±0.1 |
| SW shutdown | SW cutoff limit (> regulator drop-out limit) MIN! | 3.2 V |

## Audio function description

The basic audio structure and communication between HW-audio modules and the audio ASIC's is illustrated in the block diagram below.


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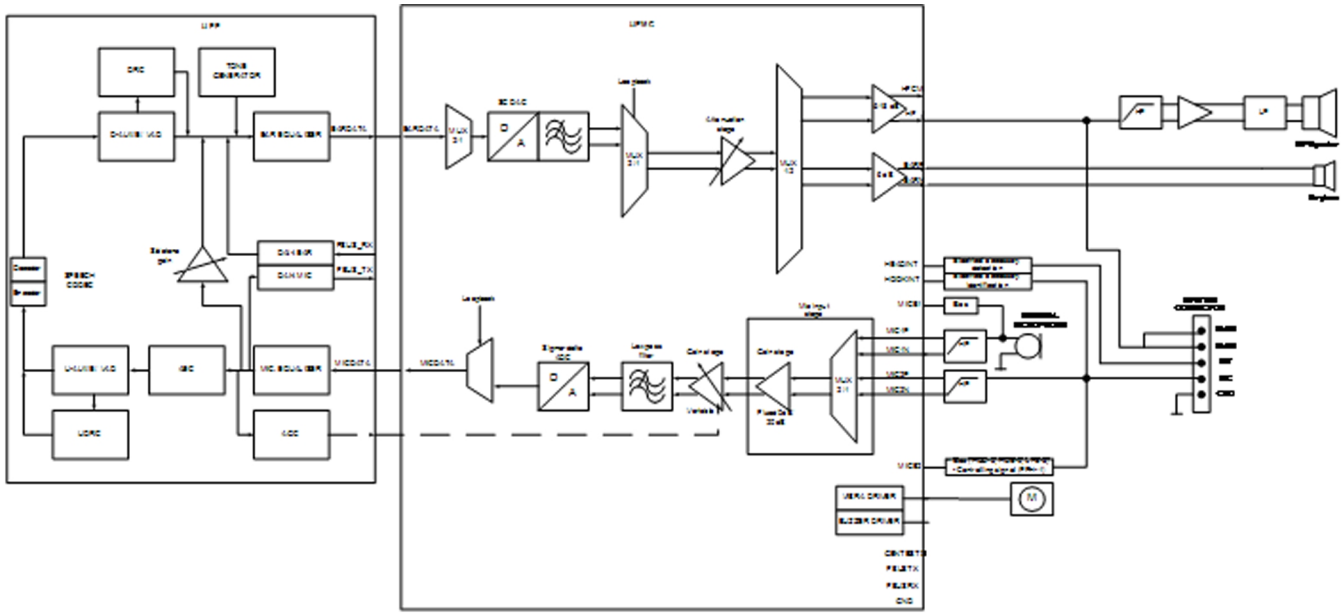


**Figure 109 Audio block diagram**

UEMcLite supports three microphone inputs and two outputs. The inputs can be used for internal, headset or handsfree microphones. The microphone signals from different sources are connected to separate inputs at the UEMcLite ASIC. The inputs and outputs are all differential.

Three inputs (MIC1, MIC2) and two outputs (EAR, HF) are used in the phone.

MIC1P/MIC1N inputs are used for the internal microphone, using single-ended biasing circuitry. EARP/EARN outputs from UEMcLite are used for hand-portable mode.

Uplink external audio (headset as well as carkit) is connected to MIC2P/MIC2N, while downlink audio is provided via the HF outputs from UEMcLite. A special situation exists since the carkit can be used with two different microphones: either the phone's internal microphone (MIC1-inputs) or an external microphone that connects to the carkit. In these cases UEMcLite is capable of switching between MIC1 and MIC2.

The audio control is taken care of by UEMcLite, which contains the MCU and audio codec. UPP contains DSP blocks, and handling and processing of the audio signals.

Input and output selection, and gain control is performed inside UEMcLite. DTMF-tones and other audio tones are generated and encoded by UPP and transmitted to UEMcLite for decoding.

## External audio connector

The system connector, containing a 4-pole Jack plug, gains the access to the external audio interface. The Jack plug, which is integrated in the system connector, contains a mechanical switch, which is used to detect the connection of the accessories. The configuration for the 4-pole Jack-plug is shown in the following figure.


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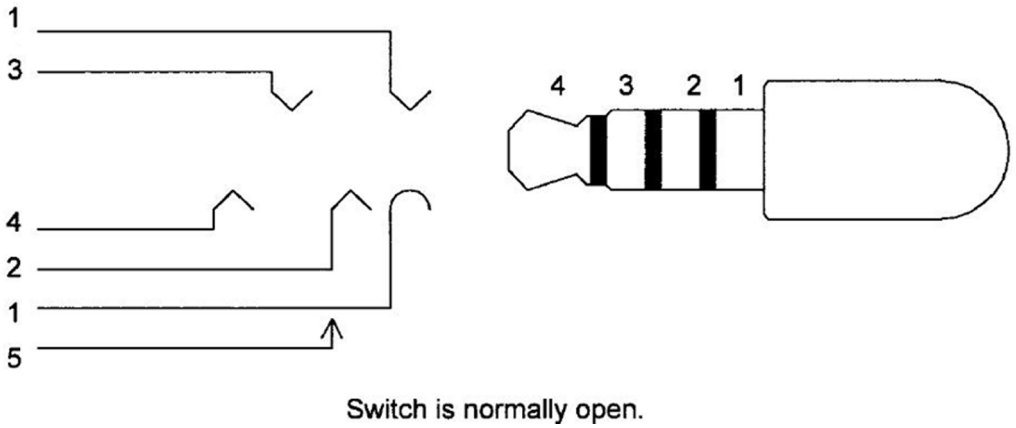



**Figure 110 4-pole jack plug for audio accessory**

**Table 9 Connector for External Audio Accessories**

| Pin | Signal name | Direction | Description |
|---|---|---|---|
| 5 | PLUGDET | Input | Terminal internal connection, plug detection |
| 4 | HS EAR L | Output | Audio output |
| 3 | HS EAR R | Output | Audio output |
| 2 | HS MIC | Input | Multiplexed microphone audio and control data |
| 1 | HS GND | - | Ground contact |

## HALL sensor

The HALL sensor is used to recognize the position of the flap.

The HALL sensor incorporates advanced chopper-stabilization techniques to provide accurate and stable magnetic switch points. The circuit design provides an internally controlled clocking mechanism to cycle power to the HALL element and analog signal processing circuits. This serves to place the high current-consuming portions of the circuit into the sleep mode. Periodically the device is awakened by this internal logic and the magnetic flux from the HALL element is evaluated against the predefined thresholds. If the flux density is above or below the BOP/BRP thresholds, the output transistor is driven to change states accordingly. While in the sleep cycle, the output transistor is latched in its previous state.

The output transistor of the SH248CSP is latched on at the presence of a sufficiently strong south or north magnetic field facing the marked side of the package. The output is latched off in the absence of a magnetic field.

The output of hall sensor is sent to GENIO24 of UPP. Baseband knows the status of the hall sensor that represents the phone position (folded or not).


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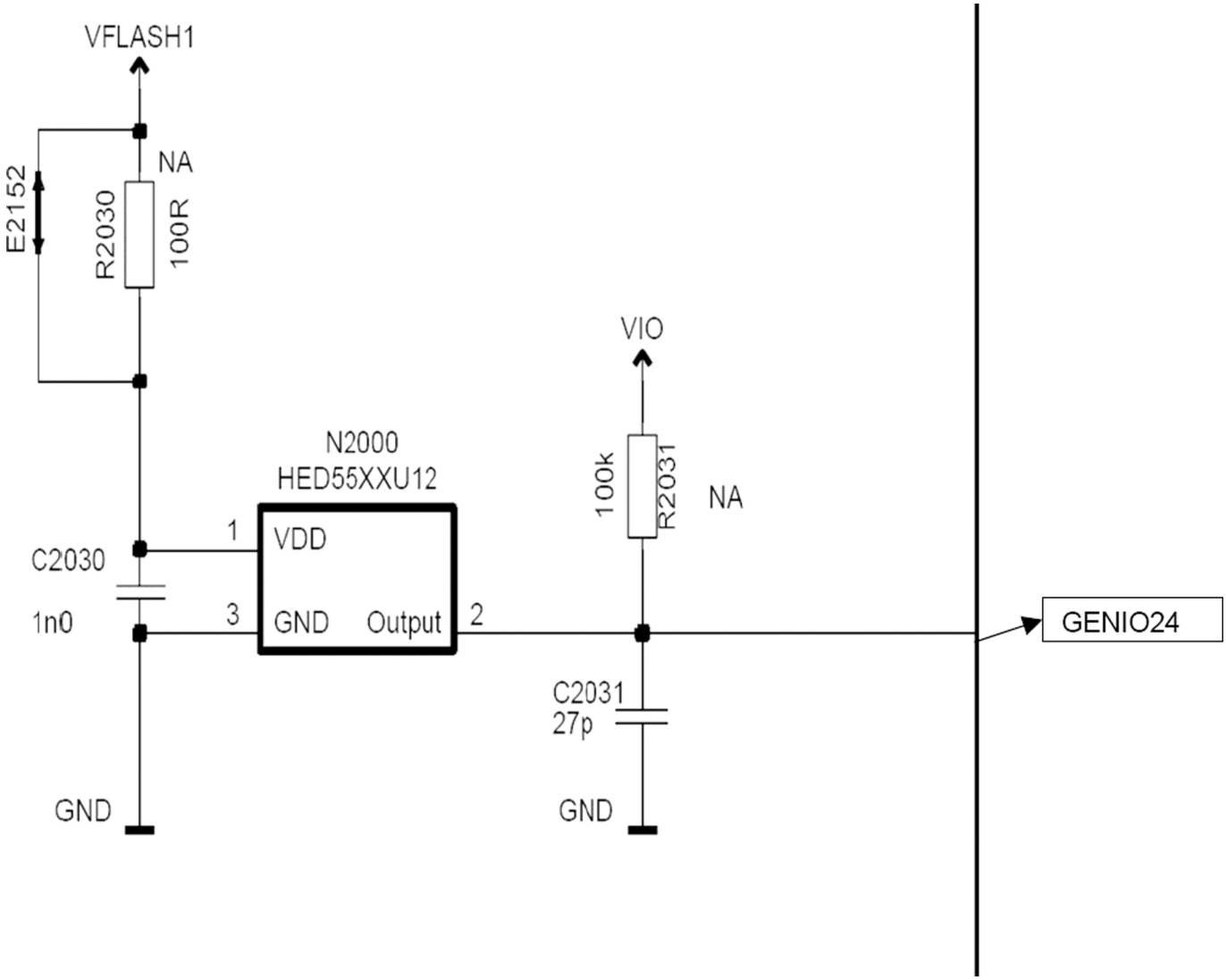



**Figure 111 HALL sensor**


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## Interfaces

### RF and baseband interfaces

**Table 10 AC and DC Characteristics of BB4.0 LiteV2 RF-Base band Digital Signals**

| Signal name | From | To | Para-meter | Input characteristics | | | | Function |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Unit | |
| TXP1 | UPP | RF-IC | 1 | 1.38 | | 1.88 | V | Depends of the RF design |
| RFGenOut3 | GenIO5 | | 0 | 0 | | 0.4 | V | |
| | | | Load Resistance | 10 | | | kW | |
| | | | Load Capacitance | | | 20 | pF | |
| | | | Timing Accuracy | | | ¼ | symbol | |
| TXP2 | UPP | RF-IC | 1 | 1.38 | | 1.88 | V | Depends of the RF design |
| | (GenIO6) | | 0 | 0 | | 0.4 | V | |
| | | | Load Resistance | 10 | | | kW | |
| | | | Load Capacitance | | | 20 | pF | |
| | | | Timing Accuracy | | | ¼ | symbol | |
| RFBusEn1X | UPP | RF-IC | 1 | 1.38 | | 1.88 | V | RFIC Chip SelX |
| | | | 0 | 0 | | 0.4 | V | |
| | | | Internal PU Current | | | 50 | uA | |
| | | | Load resistance | 10 | | | kW | |
| | | | Load capacitance | | | 20 | pF | |


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| Signal name | From | To | Para-meter | Input characteristics | | | | Function |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Unit | |
| RFBusDa | UPP / RF-IC | RF-IC/ UPP | 1 | 1.38 | | 1.88 | V | Bi-directional RF Control serial bus data, |
| | | | 0 | 0 | | 0.4 | V | |
| | | | Load resistance | 10 | | | kW | |
| | | | Load capacitance | | | 20 | pF | |
| | | | Data frequency | | | 13 | MHz | |
| RFBusClk | UPP | RF IC | 1 | 1.38 | | 1.88 | V | RF Control serial bus bit clock |
| | | | 0 | 0 | | 0.4 | V | |
| | | | Load resistance | 10 | | | kW | |
| | | | Load capacitance | | | 20 | pF | |
| | | | Data frequency | | | 13 | MHz | |
| GENIO3 | UEMCLite | RF IC | 1 | | 2.78 | | V | RF Control * |
| | | | 0 | | | | V | Depends of the RF design |
| | | | Load resistance | | | | kW | |
| | | | Output current | | | 4 | mA | |
| GENIO4 | UEMCLite | RF IC | 1 | | 2.78 | | V | Audio clock input in UEMCLiteV3 and LittiV2 |
| | | | 0 | | | | V | |
| | | | Load resistance | | | | kW | |
| | | | Output current | | | 4 | mA | |
| GENIO5 | UEMCLite | RF IC | 1 | | 2.78 | | V | RF Control * |
| | | | 0 | | | | V | Depends of the RF design |
| | | | Load resistance | | | | kW | |
| | | | Output current | | | 4 | mA | |


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## Analogue Signals

**Table 11 AC and DC Characteristics of RF-Base band Analogue Signals**

| Signal name | From | To | Parameter | Min | Typ | Max | Unit | Function |
|---|---|---|---|---|---|---|---|---|
| RFCLK | VCTCXO | UPP | Frequency | | 13/26 | | MHz | System Clk from RF to BB, |
| | | | Signal amplitude | 0.2 | 0.8 | 1.32 | Vpp | 13/26 MHz Depending on RF chipset |
| | | | Input Impedance | 10 | | | kW | UPP minimum recommended amplitude is 0.3Vpp. |
| | | | Input Capacitance | | | 10 | pF | |
| | | | Harmonic Content | | | -8 | dBc | |
| | | | Clear signal window (no glitch) | 200 | | | mVpp | |
| | | | Duty Cycle | 40 | | 60 | % | |
| RFCLKGnd | VCTCXO | UPP | DC Level | | 0 | | V | System Clock slicer Ref GND, not separated from pwb GND layer |
| RXIP, RXIN, RXQP, RXQN | RF-IC | UEMCLite | Voltage swing (static) | | 1.4 | 1.45 | Vpp | Differential positive / negative in-phase and quadrature Rx Signals. |
| | | | DC level | 1.3 | 1.35 | 1.4 | V | |
| | | | I/Q amplitude mismatch | | | 0.2 | dB | |
| | | | I/Q phase mismatch | -0.5 | | 0.5 | deg | |
| TXIP, TXIN, TXQP, TXQN | UEMCLite | RF-IC | Differential voltage swing (static) | 2.25 | | 2.45 | Vpp | Differential positive / negative in-phase and quadrature Tx Signals |
| | | | | | | | | In High-Z when RX is receiving. |
| | | | DC level | 1.17 | 1.20 | 1.23 | V | |
| | | | Source Impedance | | | 200 | W | |


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| Signal name | From | To | Parameter | Min | Typ | Max | Unit | Function |
|---|---|---|---|---|---|---|---|---|
| AFC | UEMCLite | VCTCXO | Voltage Min | 0.0 | | 0.1 | V | Automatic Frequency Control signal for VCTCXO Programmable |
| | (AFCOUT) | | Max | 2.4 | | 2.55 | | |
| | | | Resolution | 11 | | | bits | |
| | | | Load resistance | 1 | | | kW | |
| | | | and capacitance | | | 100 | nF | |
| | | | Source Impedance | | | 200 | W | |
| | | | Output impedance | 10 | | | MW | Path powered down |
| TxC | UEMCLite | RF-IC | Voltage Min | | | 0.1 | V | Transmitter power level and ramping control, Ref UEMCLite RF converter specification |
| | (AUXOUT) | | Max | 2.4 | | | | |
| | | | Source Impedance | | | 200 | W | |
| | | | Resolution | 10 | | | bits | |
| VCXOTEMP | RF-IC | UEMCLite | Input voltage range | 0 | | 2.7 | V | |
| | | | Input resistance | 900 | | 6000 | Ohm | |
| | | | Resolution | 10 | | | bits | |
| PATEMP | RF-IC | UEMCLite | Voltage at -20oC | | 1.57 | | V | Usage depends of the RF design |

## LCD interface

The display is controlled by phone processor UPP.

The main LCD module is connected to the PWB by a 24-pin board-to-board connector.

The sub LCD module is connected to the PWB by a 10-pin board-to-board connector.

## Keyboard

A 5 X 5 matrix keyboad consists of 21 keys, one 10-channel integrated passive filiter arrays with downstream ESD protection of >8KV connect the matrix keyboard to UPP.


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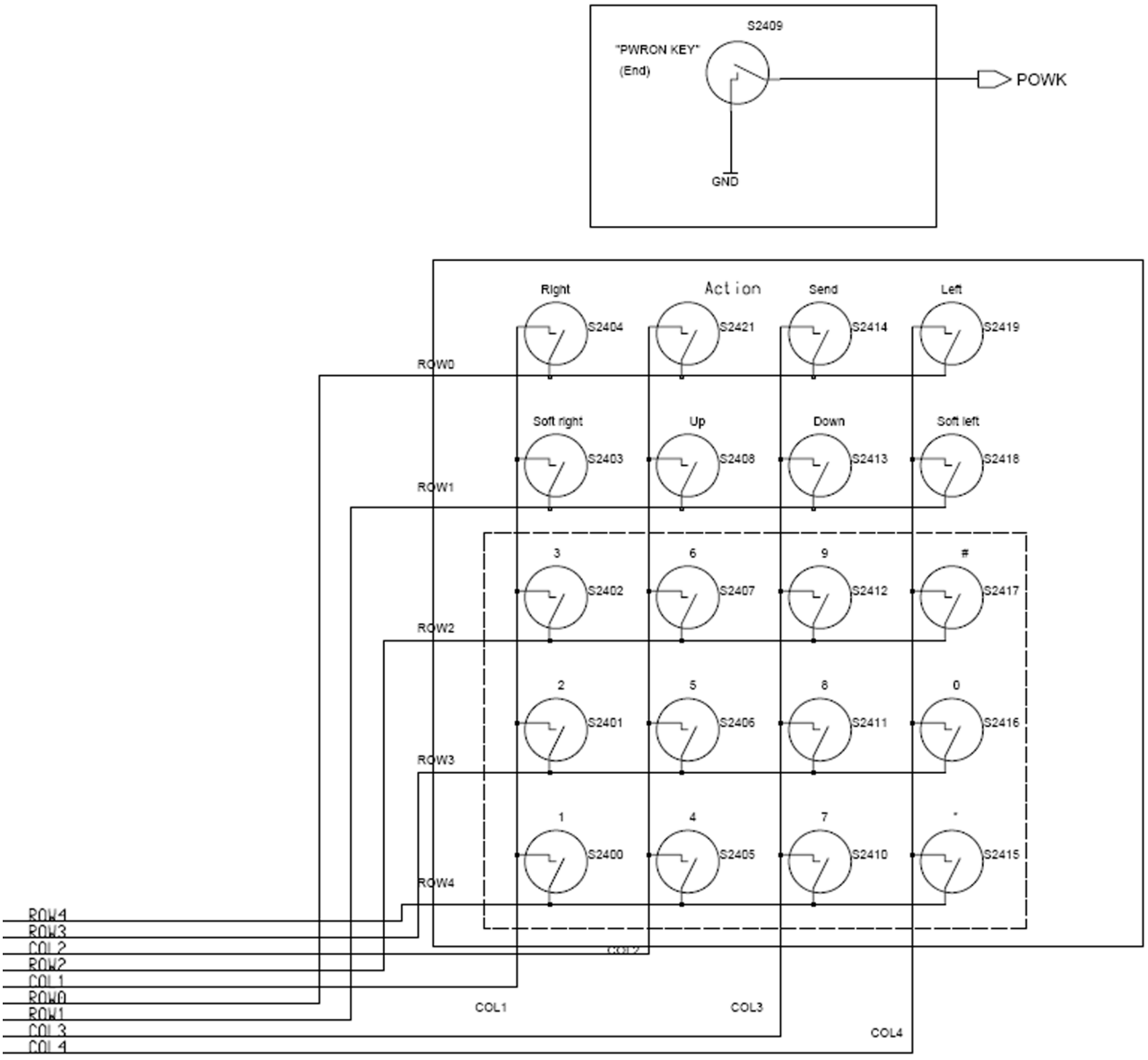



**Figure 112 Keyboard schematics**

## SIM interface

The UEMCLite contains the SIM interface logic level shifting. The SIM interface can be programmed to support 3V and 1.8V SIMs. SIM supply voltage is selected by with register in the UEMCLite. It is only allowed to change the SIM supply voltage when the SIM IF is powered down.

The SIM power up/down sequence is generated in the UEMCLite. This means that the UEMCLite generates the RST signal to the SIM. In addition, the SIMCardDet signal is connected to UEMCLite. The detection is taken from the BSI signal, which detects the removal of the battery. The monitoring of the BSI signal is done by a comparator inside UEMCLite. The comparator offset is such that the comparator outputs do not alter state as long as the battery is connected. The threshold voltage is calculated from the battery size specifications.

The SIM interface is powered up when the SIMCardDet signal indicates ”card in”. This signal is derived from the BSI signal.


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**Table 12 SIM interface**

| Pin | Name | Parameter | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|---|
| 4 | DATA | 1.8V Voh | 0.9xVSIM | | VSIM | V | SIM data (output) |
| | | 1.8V Vol | 0 | | 0.15xVSIM | | |
| | | 3V Voh | 0.9xVSIM | | VSIM | | |
| | | 3V Vol | 0 | | 0.15xVSIM | | |
| | | 1.8V Vih | 0.7xVSIM | | VSIM | V | SIM data (input) |
| | | 1.8V Vil | 0 | | 0.15xVSIM | | Trise/Tfall max 1us |
| | | 3V Vil | 0.7xVSIM | | VSIM | | |
| | | 3V Vil | 0 | | 0.15xVSIM | | |
| 5 | NC | | | | | | Not connected |
| 6 | GND | GND | 0 | | 0 | V | Ground |
| VSIM specified in regulator section in this document | | | | | | | |

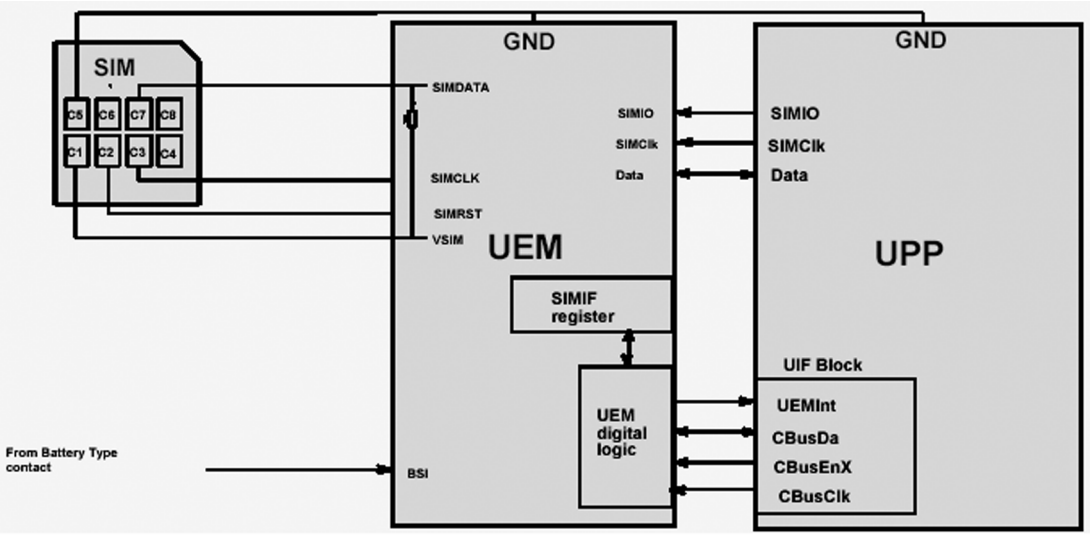



**Figure 113 SIM interface block diagram**


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## External signals and connections

**Table 13 System connector**

| Signal | From | To | Min | Nom | Max | Condi-tion | Note |
|---|---|---|---|---|---|---|---|
| XMICP | HS/HF Mic | UEMC Lite | | 2/60m V diff | | Analog audio in | Headset Mic bias and audio signal 2mV nominal. HF Mic signal 60mV nominal. Differential symmetric input. |
| | | | | | | DC bias 2V2kohm | Accessory detection by bias loading |
| XMICN | | | | 2/60m V diff | | Ana in / 1k to GND | Hook interrupt by heavy bias loading |
| XEARP | HS/HF | UEMC Lite | | 100 mV diff | | Ana in | Quasi-differential DC-coupled earpiece/HF amplifier signal to accessory. DC biased to 0.8V |
| XEARN | EAR/ Amp. | | | | | | |
| INT HEADINT | Switch | UEMC Lite | | 0/2.7V | | Dig in | HS interrupt from bottom connector switch when plug inserted. |
| VCHARIN | Charger | UEMC Lite | | 11.1Vp eak | 16.9 Vpeak | Standard | Vch from Charger Connector, max 20V |
| | | | | | 7.9 VRMS | | |
| | | | | | 1.0 Apeak | | |
| | | | 7.0 VRMS | 8.4 VRMS | 9.2 VRMS | Fast charger | |
| | | | | | 850 mA | | |
| GND | | | | | GND | | GND from/to Charger connector |

## Battery connector

**Table 14 Battery IF**

| Signal | From | To | Min | Nom | Max | Note |
|---|---|---|---|---|---|---|
| GND | Global | Batt (-) | | | | Global GND |
| VBAT | | Batt (+) | 3.1 | | 5.1 | Battery Voltage |


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| Signal | From | To | Min | Nom | Max | Note |
|---|---|---|---|---|---|---|
| BSI | | UEMCLite | 0 | | 2.78 | Analog input, Battery Size Indicator Resistor, 100 kohm pull up to 2.78V (VBB1). FDL Init, refer to flash download. |

## Battery interface

- Type: BL-4B
- Technology: Li-Ion, 4.2 V charging, 3.1 V cut-off
- Capacity: 700 mAh.

BL-4B has a 3 pin interface with overcharge / discharge protection (safety circuit) and battery size indication BSI with an internal resistor. The BSI fixed resistor value indicates type and default capacity of a battery.

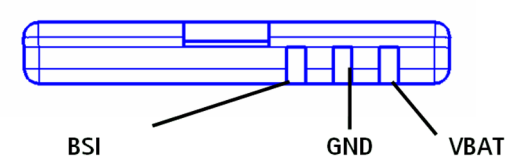



**Figure 114 BL-4B battery pack contacts**

**Table 15 Pin numbering of battery pack**

| Signal name | Pin number | Function |
|---|---|---|
| GND | 2 | Negative/common battery terminal |
| BSI | 3 | Battery capacity measurement (fixed resistor inside the battery pack) |
| VBAT | 1 | Positive battery terminal |


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## PWB outline

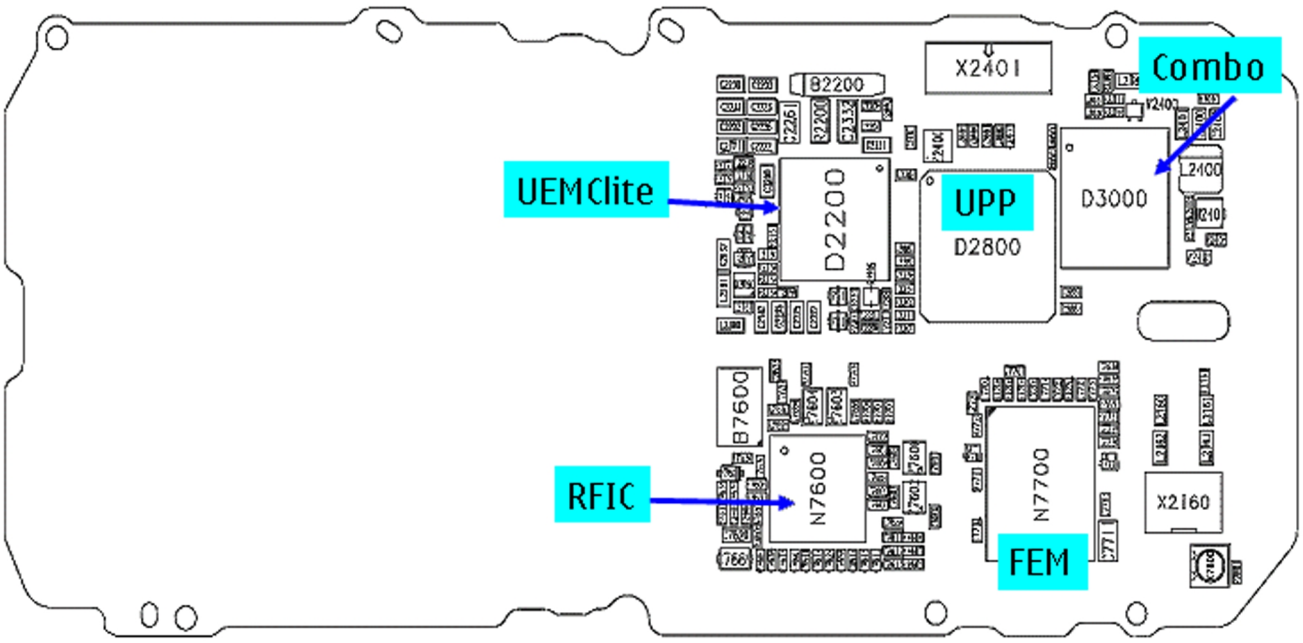



**Figure 115 PWB top side component placement**

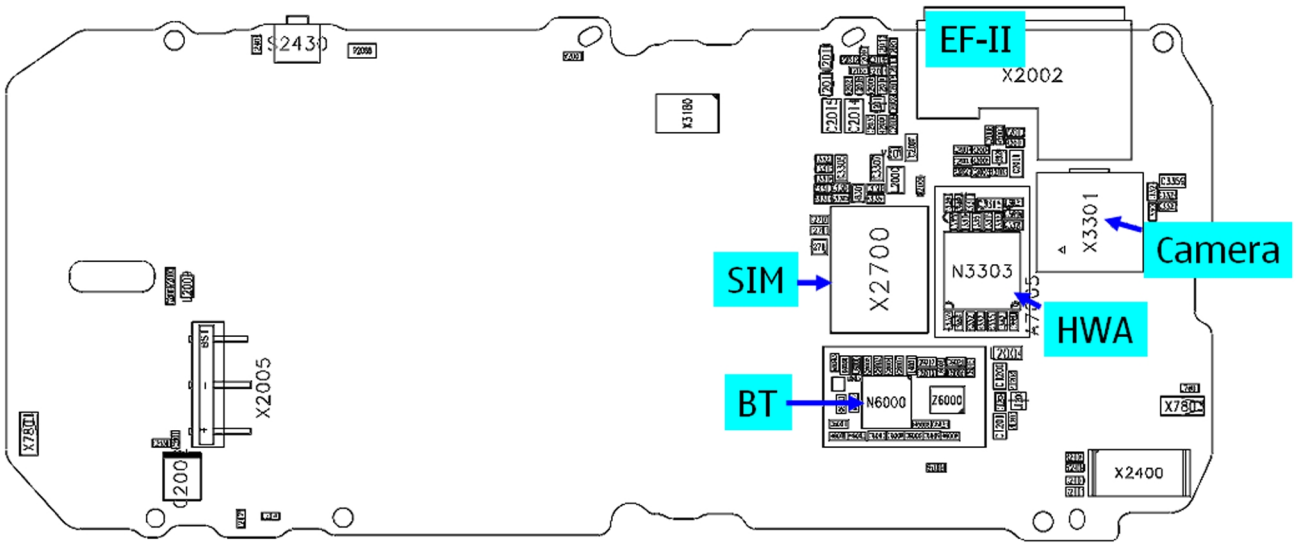



**Figure 116 PWB bottom side component placement**

# RF description

## Frequency band, power and multi-slot class

The requirement leads to the specification in the table below:


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**Table 16 Frequency bands and TX power class**

| System | Frequency band | TX power class |
|---|---|---|
| GSM900 | Tx: 880 – 915 MHz | 4 (33dBm) |
| | Rx: 925 – 960 MHz | |
| GSM1800 | Tx: 1710 – 1785 MHz | 1 (30dBm) |
| | Rx: 1805 – 1880 MHz | |

**Table 17 Multi-slot class**

| Multislot Class | |
|---|---|
| GPRS | MSC 10 (4Dn/2Up), sum=5 |
| E-GPRS | MSC 6 in DL, max. 3Dn |

## Transmitter - general description

The transmitter has separate, parallel paths covering the different bands. The transmitter operates in GMSK mode only. The power level control circuitry is integrated in the front-end module.

Each path of the transmitter is composed of a baseband lowpass filter for the I/Q signals and a quadrature direct modulator integrated in PMB3258. At the modulator's output there is a bandpass filter for each band (so-called H3 filter) and a balun transformer to convert the differential output signal from the modulator into a single-ended 50 ohm signal. This signal is fed into the input of the PA. The two power amplifiers and the antenna switch are integrated in a single module with built-in power control loop.

The two control methods used are open-loop Vcc control (RFMD) and feedback control with current sensing. The reference waveform (TXC) for the control loop comes from the baseband. The output of the PA goes into a low pass filter located inside the FEM (Front End Module). Finally the transmit signal goes through the band selection and TX/RX switches to the antenna port.

The FEM is controlled with four digital control signals (TXP, Vc1, Vc2 and Vc3) to meet the TDMA frame timing requirements.

## Transmitter - signal processing

The I/Q signals coming from the baseband section are fed into the modulator and converted up to the carrier frequency. The I/Q are post filtered by a 1st order passive RC filter (discrete components on PWB) and a 3rd order active filter (Legendre type) inside PMB3258.

The nominal output level of the modulator is +3.5 dBm in both bands. The modulator's output is an open-collector type and need an external load and a DC supply feed. The load and the DC supply feed are implemented as the part of the H3 filter.

The filtered signal is fed into the input of the FEM, which amplifies it to the desired power level and provides the signal at the antenna port.

There is also a temperature sensor close to the FEM to enable SW temperature compensation for e.g. the power levels. The sensor is connected to one of the slow ADC channels in the baseband.

## Receiver - general description

The receiver is a direct conversion linear receiver. It is a dual-band receiver with receiver paths for either GSM850/1900 or GSM900/1800 configuration.


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From the antenna, the received RF-signal is fed into the front-end module, which routes the signal to the appropriate RX path. After the FEM, the RX signals are filtered by SAW filters (one for each band), which reject the out-of band blocking signals to low enough level to be handled by the RF ASIC.

There are two paths – one for each band. In each path, the signal is then fed to the low noise amplifier (LNA). One LNA can handle both the GSM850 and GSM900 signals and another is used for GSM1800 and GSM1900. The LNA inputs are matched to the SAW filter outputs by means of discrete LC matching networks. The SAW filters and the matching networks are different for different band combinations, but the PWB layout is the same for both 850/1900 and 900/1800 versions.

The RX front-end circuitry contains the LNA and the quadrature down converting mixers. The front-end gain is programmable so that the gain can be reduced in strong-signal conditions. The mixers at each signal path convert the RF signal directly down to baseband I/Q signals. Local oscillator signals for the mixers are generated by an on-chip VCO.

The output signals (I/Q) of each demodulator are all differential. They are combined to two differential signal paths, one for I-channel and one for Q-channel, common for all bands. The baseband RX signals are then fed into a 3rd order active blocking filter, which has programmable gain. One of the three poles is implemented by an off-chip capacitor connected directly between the mixer outputs. There are a total of two off-chip capacitors, one for I-channel and one for Q-channel, respectively.

After the blocking filter, the signal is fed into a buffer amplifier, which also has programmable gain. Around the amplifier there is the first DC-offset compensation block, which removes most of the cumulated DC offset so far. The DC offset compensation method is based on digital successive approximation technique.

The next block in the RX chain is a switched-capacitor (SC) channel filter, which provides the close-in selectivity for the analog receiver. Because the SC-filter is insensitive to the IC process tolerances, no production calibration of the filter is necessary. The SC-filter operates on 6.5 MHz clock, which is generated by dividing the 26 MHz reference clock by four.

After the SC-filter there is a continuous-time smoothing filter which attenuates the alias signals generated by the sampling process inherent in the SC-filter. The smoothing filter also has programmable gain.

The next block is a programmable gain amplifier (PGA), which has the second DC-offset compensation block around it. The DC-offset compensation method is again based on digital successive approximation technique.

The last block in the analog receiver is an output buffer amplifier, which feeds the differential I/Q signals off-chip to be A/D converted in the digital baseband.

## VCXO and PLL

The VCO frequency is locked by a PLL (phase locked loop) into a stable frequency source given by a VCXO. The frequency of the VCXO is in turn locked into the frequency of the base station with the help of an AFC (automatic frequency control) voltage, which is generated in the UEM. The reference frequency is 26 MHz.

The VCXO also provides a 26 MHz system clock for the digital baseband.

The PLL is located in PMB3258 and it is controlled via the RFBUS.


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# Glossary


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| | |
|---|---|
| A/D-converter | Analog-to-digital converter |
| ACI | Accessory Control Interface |
| ADC | Analog-to-digital converter |
| ADSP | Application DPS (expected to run high level tasks) |
| AGC | Automatic gain control (maintains volume) |
| ALS | Ambient light sensor |
| AMSL | After Market Service Leader |
| ARM | Advanced RISC Machines |
| ARPU | Average revenue per user (per month or per year) |
| ASIC | Application Specific Integrated Circuit |
| ASIP | Application Specific Interface Protector |
| B2B | Board to board, connector between PWB and UI board |
| BB | Baseband |
| BC02 | Bluetooth module made by CSR |
| BIQUAD | Bi-quadratic ,type of filter function) |
| BSI | Battery Size Indicator |
| BT | Bluetooth |
| CBus | MCU controlled serial bus connected to UPP_WD2,UEME and Zocus |
| CCP | Compact Camera Port |
| CDSP | Cellular DSP (expected to run at low levels) |
| CLDC | Connected limited device configuration |
| CMOS | Complimentary metal-oxide semiconductor circuit (low power consumption) |
| COF | Chip on Foil |
| COG | Chip on Glass |
| CPU | Central Processing Unit |
| CSR | cambridge silicon radio |
| CSTN | Color Super Twisted Nematic |
| CTSI | Clock Timing Sleep and interrupt block of Tiku |
| CW | Continuous wave |
| D/A-converter | Digital-to-analouge converter |
| DAC | Digital-to-analouge converter |
| DBI | Digital Battery Interface |
| DBus | DSP controlled serial bus connected between UPP_WD2 and Helgo |
| DCT-4 | Digital Core Technology |
| DMA | Direct memory access |
| DP | Data Package |


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| | |
|---|---|
| DPLL | Digital Phase Locked Loop |
| DSP | Digital Signal Processor |
| DtoS | Differential to Single ended |
| EDGE | Enhanced data rates for global/GSM evaluation |
| EGSM | Extended GSM |
| EM | Energy management |
| EMC | Electromagnetic compability |
| EMI | Electromagnetic interference |
| ESD | Electrostatic discharge |
| FCI | Functional cover interface |
| FPS | Flash Programming Tool |
| FR | Full rate |
| FSTN | Film compensated super twisted nematic |
| GMSK | Gaussian Minimum Shift Keying |
| GND | Ground, conductive mass |
| GPIB | General-purpose interface bus |
| GPRS | General Packet Radio Service |
| GSM | Group Special Mobile/Global System for Mobile communication |
| HF | Hands free |
| HFCM | Handsfree Common |
| HS | Handset |
| HSCSD | High speed circuit switched data (data transmission connection faster than GSM) |
| HW | Hardware |
| I/O | Input/Output |
| IBAT | Battery current |
| IC | Integrated circuit |
| ICHAR | Charger current |
| IF | Interface |
| IHF | Integrated hands free |
| IMEI | International Mobile Equipment Identity |
| IR | Infrared |
| IrDA | Infrared Data Associasion |
| ISA | Intelligent software architecture |
| JPEG/JPG | Joint Photographic Experts Group |
| LCD | Liquid Crystal Display |
| LDO | Low Drop Out |


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| | |
|---|---|
| LED | Light-emitting diode |
| LPRF | Low Power Radio Frequency |
| MCU | Micro Controller Unit (microprocessor) |
| MCU | Multiport control unit |
| MIC, mic | Microphone |
| MIDP | Mobile Information Device Profile |
| MIN | Mobile identification number |
| MIPS | Million instructions per second |
| MMC | Multimedia card |
| MMS | Multimedia messaging service |
| NTC | Negative temperature coefficient, temperature sensitive resistor used as a temperature sensor |
| OMA | Object management architechture |
| OMAP | Operations, maintenance, and administartion part |
| Opamp | Operational Amplifier |
| PA | Power amplifier |
| PDA | Pocket Data Application |
| PDA | Personal digital assistant |
| PDRAM | Program/Data RAM (on chip in Tiku) |
| Phoenix | Software tool of DCT4.x |
| PIM | Personal Information Management |
| PLL | Phase locked loop |
| PM | (Phone) Permanent memory |
| PUP | General Purpose IO (PIO), USARTS and Pulse Width Modulators |
| PURX | Power-up reset |
| PWB | Printed Wiring Board |
| PWM | Pulse width modulation |
| RC-filter | Resistance-Capacitance filter |
| RF | Radio Frequency |
| RF PopPort TM | Reduced function PopPortTM interface |
| RFBUS | Serial control Bus For RF |
| RSK | Right Soft Key |
| RS-MMC | Reduced size Multi Media Card |
| RSSI | Receiving signal strength indicator |
| RST | Reset Switch |
| RTC | Real Time Clock (provides date and time) |


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| | |
|---|---|
| RX | Radio Receiver |
| SARAM | Single Access RAM |
| SAW filter | Surface Acoustic Wave filter |
| SDRAM | Synchronous Dynamic Random Access Memory |
| SID | Security ID |
| SIM | Subscriber Identity Module |
| SMPS | Switched Mode Power Supply |
| SNR | Signal-to-noice ratio |
| SPR | Standard Product requirements |
| SRAM | Static random access memory |
| STI | Serial Trace Interface |
| SW | Software |
| SWIM | Subscriber/Wallet Identification Module |
| TCXO | Temperature controlled Oscillator |
| Tiku | Finnish for Chip, Successor of the UPP |
| TX | Radio Transmitter |
| UART | Universal asynchronous receiver/transmitter |
| UEME | Universal Energy Management chip (Enhanced version) |
| UEMEK | See UEME |
| UI | User Interface |
| UPP | Universal Phone Processor |
| UPP_WD2 | Communicator version of DCT4 system ASIC |
| USB | Universal Serial Bus |
| VBAT | Battery voltage |
| VCHAR | Charger voltage |
| VCO | Voltage controlled oscillator |
| VCTCXO | Voltage Controlled Temperature Compensated Crystal Oscillator |
| VCXO | Voltage Controlled Crystal Oscillator |
| Vp-p | Peak-to-peak voltage |
| VSIM | SIM voltage |
| WAP | Wireless application protocol |
| WD | Watchdog |
| XHTML | Extensible hypertext markup language |
| Zocus | Current sensor, (used to monitor the current flow to and from the battery) |


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